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NATIONAL GEOGRAPHIC

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Wattled Crane (*Bucrocerus carunculatus*) **Size:** Height, 150-160 cm **Weight:** 7-9 kg **Habitat:** Wetlands in south-central Africa and Ethiopia **Surviving number:** Estimated at 13,000-15,000

Photographed by Theo Allofs



WILDLIFE AS CANON SEES IT

A wattled crane walks slowly through shallow wetlands, searching for tubers, roots and various aquatic life. This non-migratory crane is highly dependent on undisturbed marshes and floodplains for its feeding and nesting habitat. Nesting pairs usually produce one egg per clutch, with the longest incubation period of any crane at nearly 40 days. The fledging period is also long, making the chick vulner-

able to predation. Rarest of Africa's six crane species, the wattled crane has declined over much of its range; it is threatened by habitat loss and degradation, and by disturbance due to human activity. As a global corporation committed to social and environmental concerns, we join in worldwide efforts to promote greater awareness of endangered species for the benefit of future generations.

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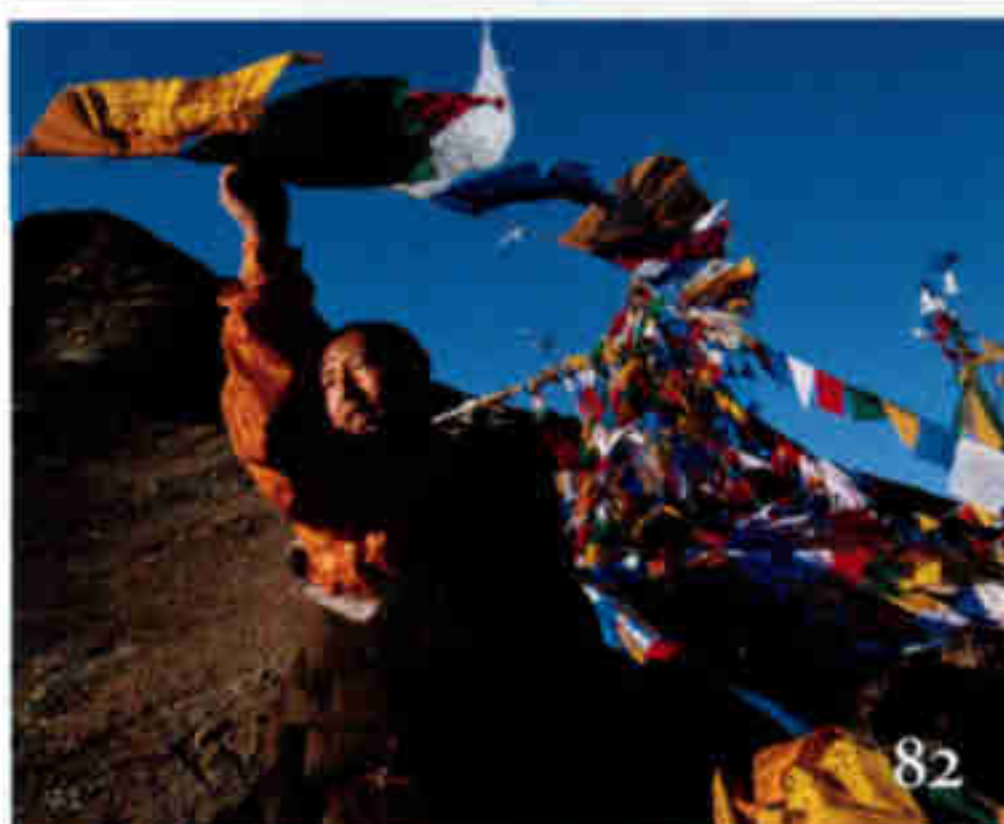
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NATIONAL
GEOGRAPHIC

JANUARY 2000



- 2 **Celebrations of Earth** *From mist-wreathed Chinese mountains to the wind-scourged Saudi desert, a gallery of photographs captures some of the most striking vistas of our planet as we begin the year 2000.*

PHOTO ESSAY BY STUART FRANKLIN

- 24 **Life Beyond Earth** *What's out there? Astronomers have searched for signs of extraterrestrial life for centuries. They have yet to find an alien microbe, much less intelligent life, but the eyes of science are seeing farther than ever before.*

BY JOEL ACHENBACH PHOTOGRAPHS BY PETER ESSICK

- 52 **Rediscovering America** *A British-born author and a Polish photographer travel across the United States—each for a second time—in search of hope, harmony, and their own American dream.*

BY TIM BROOKES PHOTOGRAPHS BY TOMASZ TOMASZEWSKI

- 82 **Tibet Embraces the New Year** *In a sacred and festive celebration each winter, Tibetan Buddhists perform rituals to secure prosperity for the months ahead.*

BY IAN BAKER PHOTOGRAPHS BY MARIA STENZEL

- 94 **The Enigma of Beauty** *We humans care passionately about how we look. Throughout history and in every part of the world we have primped, preened, posed, and sometimes put our health on the line—all for an ideal no one can truly define.*

BY CATHY NEWMAN PHOTOGRAPHS BY JODI COBB

- 122 **Light in the Deep** *For a quarter century David Doubilet has dived beneath the ocean's surface to astonish us with illuminating images of this dark realm.*

BY PETER BENCHLEY PHOTOGRAPHS BY DAVID DOUBILET

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The Cover

A Hubble image of the nebula NGC 3603 is an apt symbol of human-kind's reach into the distant universe. Photograph by Wolfgang Brandner, Eva Grebel, You-Hua Chu, and NASA

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On Assignment



BOTH BY TOMASZ TOMASZEWSKI

■ ACROSS AMERICA

On the Road Again

"He's a connoisseur of kitsch," says London-born writer Tim Brookes of Polish photographer Tomasz Tomaszewski (left). On the second trip he's taken across America for the GEOGRAPHIC, Tomasz indulged his weakness at a South Dakota joke-photo stand and snapped Tim (above) at a similar spot near Utah's Bryce Canyon, where tourists can pose with a stuffed bull. "This is the kind of adolescent goofiness you have to expect from two middle-aged guys on a road trip," says Tim, who teaches writing and cricket at the University of Vermont.



MARIA STENZEL

■ TIBETAN NEW YEAR

In a Sacred Place

While visiting a remote nunnery in southern Tibet, writer Ian Baker met an itinerant holy man, Lama Osel Lhundrup Dorje, who invited him to a sacred cave—accessible only by ladders and yak-hair ropes. There Ian, at right, a longtime Buddhist, joined the lama for a meditation retreat following the Tibetan New Year.

Ian spent his youth moving all over the world and now lives in Kathmandu, Nepal, the perfect base, he says, for a life divided between writing and exploring.



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■ NGS RESEARCH GRANT

Fossil Bonanza in a Brazilian Cave

The longest cave in the Southern Hemisphere, Brazil's Toca da Boa Vista turns out to be scientifically spectacular too. "We recovered thousands of fossils from 30 to 40 different species, mostly extinct mammals," says California paleontologist Walter Hartwig, co-leader of the first scientific survey of the 60-mile-long cave in the eastern state of Bahia. Hartwig worked with Grupo Bambui, a caving team that

found this skull of a 55-pound spider monkey, more than twice the size of those today.

They collected bones of large cats, llamas, a 20-foot-long ground sloth, small rodents, and tiny bats. Some of the creatures lived in forests, others on the plains or high in the mountains. The absence of any signs of human presence and the variety of habitats suggest environmental changes caused the animals' extinction, Hartwig says.



ADRIANO GAMBARINI (TOP); GENE J. PUSKAR, ASSOCIATED PRESS

Face-lift for Fallingwater

Time, the elements, and gravity have taken their toll on an aging beauty, architect Frank Lloyd Wright's residential masterpiece, Fallingwater. The roof and windows leak, and the famed cantilevered concrete terraces over the Bear Run waterfall sag, requiring steel beams for temporary support (left). The Western Pennsylvania Conservancy, which operates the 1930s edifice, will embark this fall on a seven-million-dollar restoration effort. A key feature: new steel cables hidden within the terraces will shore up the structures.

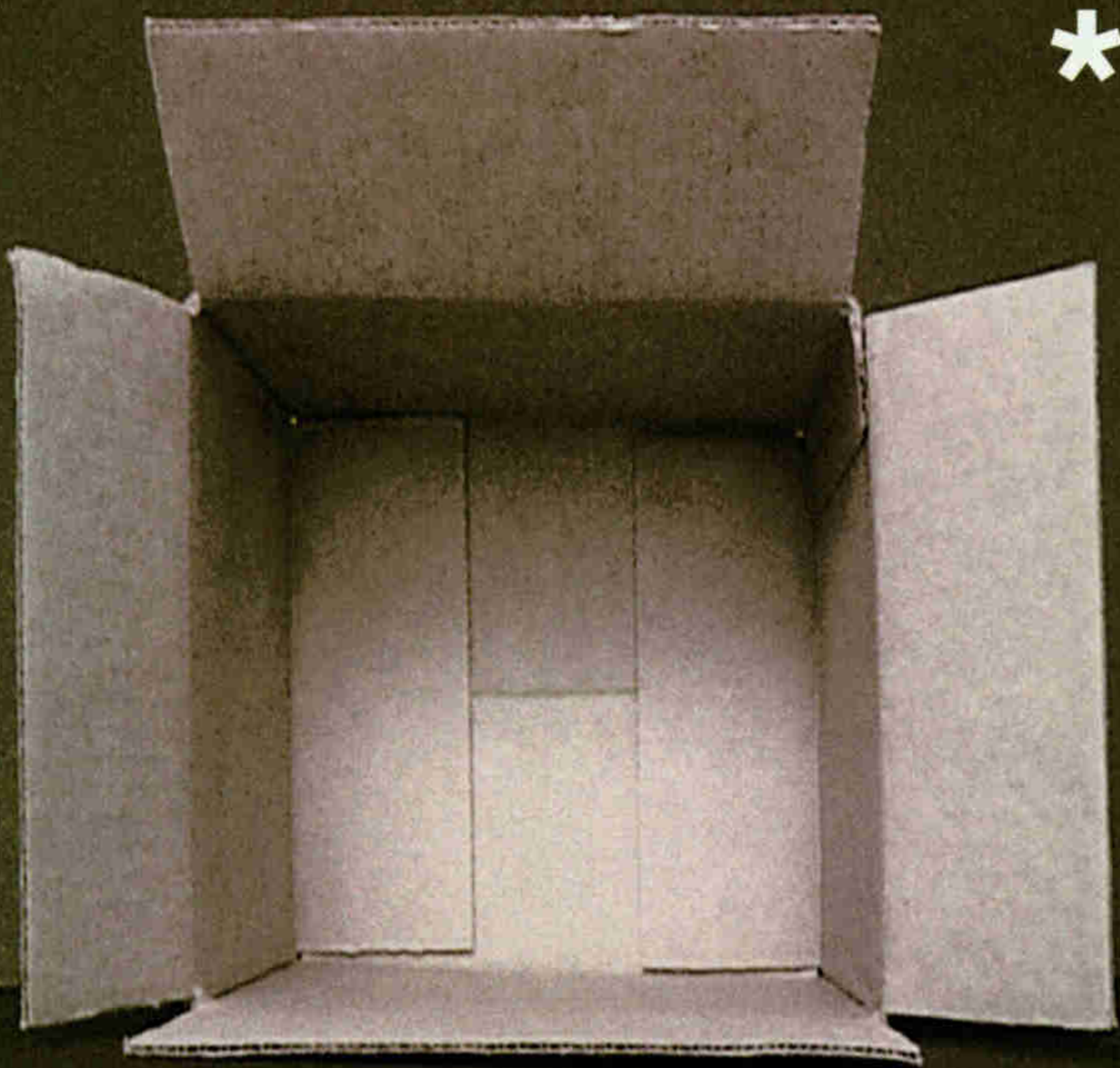


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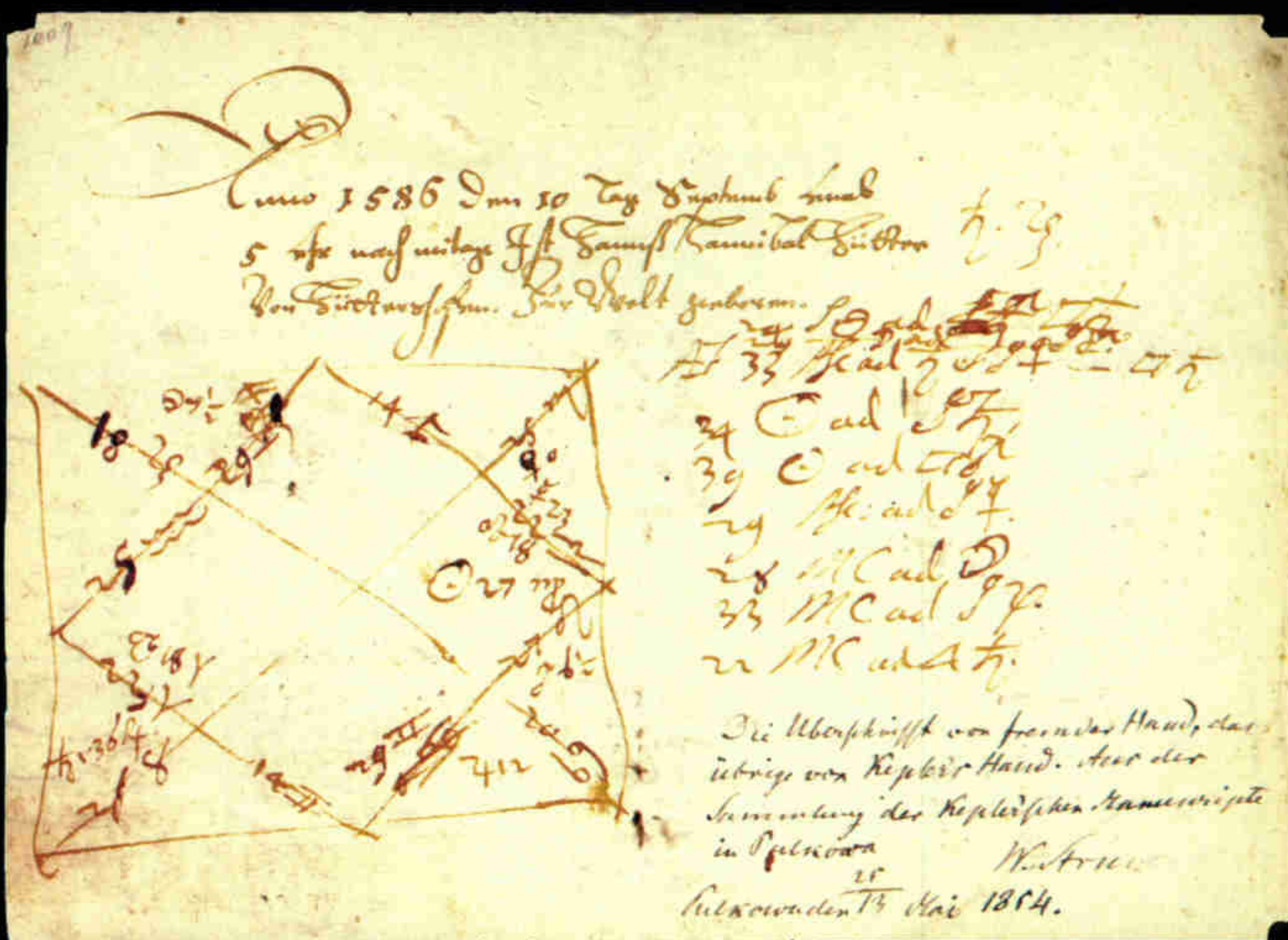
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To Kepler, It Was in the Stars

Even geniuses have to earn a living, so the great German astronomer Johannes Kepler, who discovered the laws of planetary motion, toiled as mathematician for Holy Roman Emperor Rudolf II. In addition, he was called upon to chart a horoscope for an Austrian nobleman alliteratively named Hans Hannibal Hütter von Hüttershofen, born at 5 p.m.

on September 10, 1586. In 1998 Anthony Misch of California's Lick Observatory found that horoscope (above) lodged beneath other papers in a drawer at the University of California, Santa Cruz, McHenry Library, which holds the observatory's early records.

A Berlin expert verified the document, with its 12 zodiacal symbols, as being in Kepler's hand. "It's a palpable connection to a giant of science," Misch says.

A Rock of the Ages

There doesn't seem to be much to this little piece of rock just a tenth of an inch thick, but looks can be deceiving. While examining a sediment core extracted from the North Pacific Ocean, Frank T. Kyte, a UCLA geochemist, spotted the small chunk "sticking out like a sore thumb" amid the surrounding brown clay. His analysis of the clay showed high levels of iridium and minerals typical of the geologic

layer that marks the end of the Cretaceous period, 65 million years ago.

Kyte concluded that the rock came from the meteorite that struck Earth at that time and, most scientists believe,

ended the era of the dinosaurs.

At the time of impact, the North Pacific Ocean site was some 5,600 miles west of the Yucatán Peninsula, where experts believe the meteorite struck. Kyte thinks the force of the impact blasted the intruder apart and sent its pieces into temporary orbit before some fell back to Earth. The rock's texture and its chemical composition indicate that it probably came from an asteroid and not a comet, as some experts have suggested, says Kyte.

TEXT BY BORIS WEINTRAUB



FRANK T. KYTE

***If You're Trying To Lower
Your Cholesterol, But
Your Numbers Still
Come Up High...***



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LIPITOR also significantly lowers total cholesterol and triglycerides while raising HDL "good" cholesterol. And LIPITOR is taken only once a day, at any time of day, with or without food.

ONLY YOUR DOCTOR

or healthcare provider knows if LIPITOR is

right for you. Some people should not take LIPITOR, including those with liver disease or possible liver problems, women who are nursing, pregnant, or who may become pregnant, or people who are allergic to any of the ingredients in LIPITOR. It's important to tell your doctor about any medications you are currently taking to avoid possible serious drug interactions. Your doctor may perform simple blood tests to monitor liver function before and during treatment.

LIPITOR IS GENERALLY WELL TOLERATED.

Side effects are usually mild and temporary. In clinical studies, less than 2% of patients had to stop taking LIPITOR because of adverse effects. If you take LIPITOR, tell your doctor about any unusual muscle pain or weakness, as this could be a sign of serious side effects.

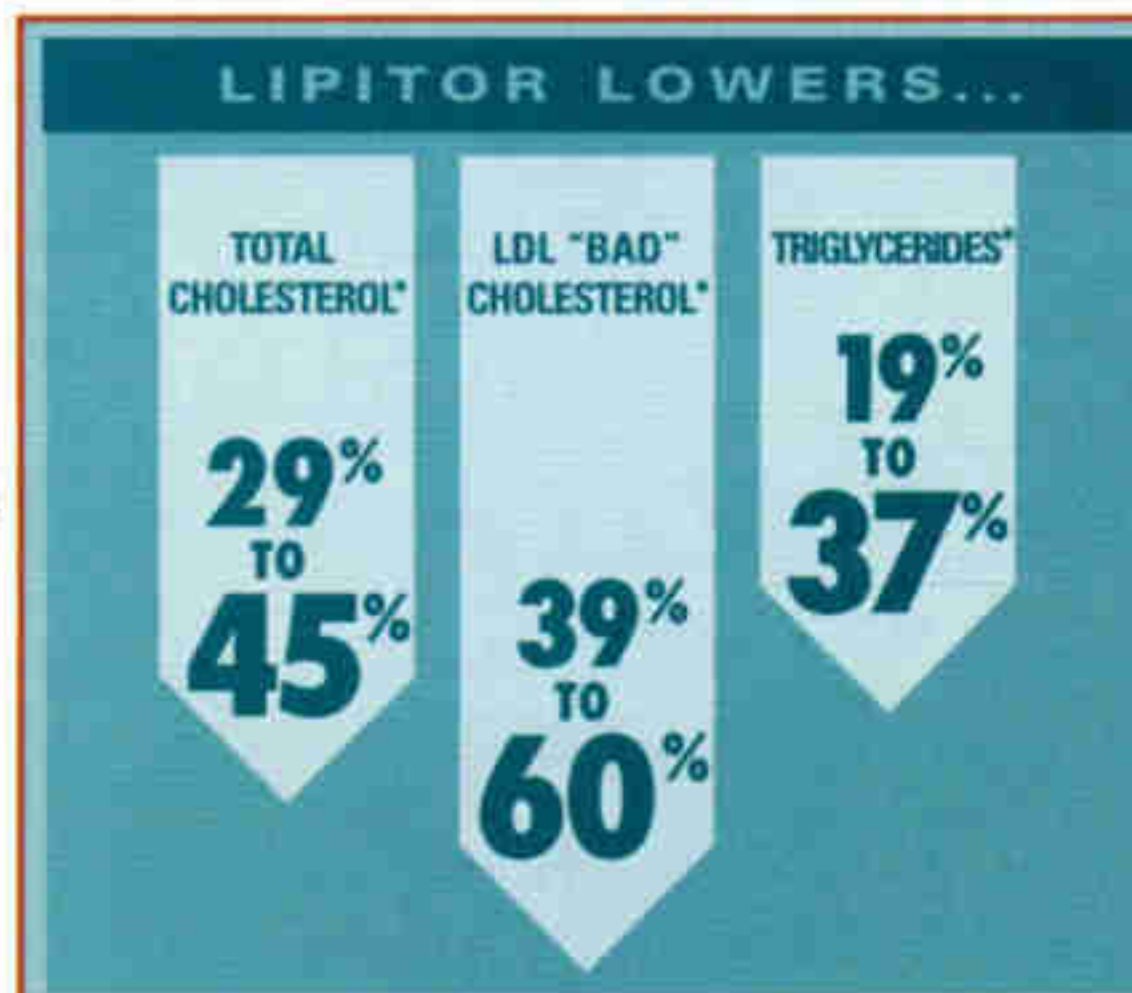


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Please see important additional information on adjacent page.



*Results of two placebo-controlled dose-response studies of 10 to 80 mg of LIPITOR in high cholesterol patients.

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atorvastatin calcium
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LIPITOR® (Atorvastatin Calcium) Tablets
Brief Summary of Prescribing Information

CONTRAINDICATIONS: Active liver disease or unexplained persistent elevations of serum transaminases. Hypersensitivity to any component of this medication. **Pregnancy and Lactation:** Atherosclerosis is a chronic process and discontinuation of lipid-lowering drugs during pregnancy should have little impact on the outcome of long-term therapy of primary hypercholesterolemia. Cholesterol and other products of cholesterol biosynthesis are essential components for fetal development (including synthesis of steroids and cell membranes). Since HMG-CoA reductase inhibitors decrease cholesterol synthesis and possibly the synthesis of other biologically active substances derived from cholesterol, they may cause fetal harm when administered to pregnant women. Therefore, HMG-CoA reductase inhibitors are contraindicated during pregnancy and in nursing mothers. **ATORVASTATIN SHOULD BE ADMINISTERED TO WOMEN OF CHILDBEARING AGE ONLY WHEN SUCH PATIENTS ARE HIGHLY UNLIKELY TO CONCEIVE AND HAVE BEEN INFORMED OF THE POTENTIAL HAZARDS.** If the patient becomes pregnant while taking this drug, therapy should be discontinued and the patient apprised of the potential hazard to the fetus.

WARNINGS: Liver Dysfunction — HMG-CoA reductase inhibitors, like some other lipid-lowering therapies, have been associated with biochemical abnormalities of liver function. **Persistent elevations (>3 times the upper limit of normal [ULN] occurring on 2 or more occasions) in serum transaminases occurred in 0.7% of patients who received atorvastatin in clinical trials. The incidence of these abnormalities was 0.2%, 0.2%, 0.6%, and 2.3% for 10, 20, 40, and 80 mg, respectively.** One patient in clinical trials developed jaundice. Increases in liver function tests (LFT) in other patients were not associated with jaundice or other clinical signs or symptoms. Upon dose reduction, drug interruption, or discontinuation, transaminase levels returned to or near pretreatment levels without sequelae. Eighteen of 30 patients with persistent LFT elevations continued treatment with a reduced dose of atorvastatin. **It is recommended that liver function tests be performed prior to and at 12 weeks following both the initiation of therapy and any elevation of dose, and periodically (eg, semiannually) thereafter.** Liver enzyme changes generally occur in the first 3 months of treatment with atorvastatin. Patients who develop increased transaminase levels should be monitored until the abnormalities resolve. Should an increase in ALT or AST of >3 times ULN persist, reduction of dose or withdrawal of atorvastatin is recommended. Atorvastatin should be used with caution in patients who consume substantial quantities of alcohol and/or have a history of liver disease. Active liver disease or unexplained persistent transaminase elevations are contraindications to the use of atorvastatin (see CONTRAINDICATIONS). **Skeletal Muscle — Rhabdomyolysis with acute renal failure secondary to myoglobinuria has been reported with other drugs in this class.** Uncomplicated myalgia has been reported in atorvastatin-treated patients (see ADVERSE REACTIONS). Myopathy, defined as muscle aches or muscle weakness in conjunction with increases in creatine phosphokinase (CPK) values >10 times ULN, should be considered in any patient with diffuse myalgias, muscle tenderness or weakness, and/or marked elevation of CPK. Patients should be advised to report promptly unexplained muscle pain, tenderness or weakness, particularly if accompanied by malaise or fever. Atorvastatin therapy should be discontinued if markedly elevated CPK levels occur or myopathy is diagnosed or suspected. The risk of myopathy during treatment with other drugs in this class is increased with concurrent administration of cyclosporine, fibric acid derivatives, erythromycin, niacin, or azole antifungals. Physicians considering combined therapy with atorvastatin and fibric acid derivatives, erythromycin, immunosuppressive drugs, azole antifungals, or lipid-lowering doses of niacin should carefully weigh the potential benefits and risks and should carefully monitor patients for any signs or symptoms of muscle pain, tenderness, or weakness, particularly during the initial months of therapy and during any periods of upward dosage titration of either drug. Periodic creatine phosphokinase (CPK) determinations may be considered in such situations, but there is no assurance that such monitoring will prevent the occurrence of severe myopathy. **Atorvastatin therapy should be temporarily withheld or discontinued in any patient with an acute, serious condition suggestive of a myopathy or having a risk factor predisposing to the development of renal failure secondary to rhabdomyolysis (eg, severe acute infection, hypotension, major surgery, trauma, severe metabolic, endocrine and electrolyte disorders, and uncontrolled seizures).**

PRECAUTIONS: General — Before instituting therapy with atorvastatin, an attempt should be made to control hypercholesterolemia with appropriate diet, exercise, and weight reduction in obese patients, and to treat other underlying medical problems (see INDICATIONS AND USAGE in full prescribing information). **Information for Patients** — Patients should be advised to report promptly unexplained muscle pain, tenderness, or weakness, particularly if accompanied by malaise or fever. **Drug Interactions** — The risk of myopathy during treatment with other drugs of this class is increased with concurrent administration of cyclosporine, fibric acid derivatives, niacin (nicotinic acid), erythromycin, azole antifungals (see WARNINGS, Skeletal Muscle). **Antacid:** When atorvastatin and Maalox® TC suspension were coadministered, plasma concentrations of atorvastatin decreased approximately 35%. However, LDL-C reduction was not altered. **Antipyrine:** Because atorvastatin does not affect the pharmacokinetics of antipyrine, interactions with other drugs metabolized via the same cytochrome isozymes are not expected. **Colestipol:** Plasma concentrations of atorvastatin decreased approximately 25% when colestipol and atorvastatin were coadministered. However, LDL-C reduction was greater when atorvastatin and colestipol were coadministered than when either drug was given alone. **Cimetidine:** Atorvastatin plasma concentrations and LDL-C reduction were not altered by coadministration of cimetidine. **Digoxin:** When multiple doses of atorvastatin and digoxin were coadministered, steady-state plasma digoxin concentrations increased by approximately 20%. Patients taking digoxin should be monitored appropriately. **Erythromycin:** In healthy individuals, plasma concentrations of atorvastatin increased approximately 40% with coadministration of atorvastatin and erythromycin, a known inhibitor of cytochrome P450 3A4 (see WARNINGS, Skeletal Muscle). **Oral Contraceptives:** Coadministration of atorvastatin and an oral contraceptive increased AUC values for norethindrone and ethinyl estradiol by approximately 30% and 20%. These increases should be considered when selecting an oral contraceptive for a woman taking atorvastatin. **Warfarin:** Atorvastatin had no clinically significant effect on prothrombin time when administered to patients receiving chronic warfarin treatment. **Endocrine Function** — HMG-CoA reductase inhibitors interfere with cholesterol synthesis and theoretically might blunt adrenal and/or gonadal steroid production. Clinical studies have shown that atorvastatin does not reduce basal plasma cortisol concentration or impair adrenal reserve. The effects of HMG-CoA reductase inhibitors on male fertility have not been studied in adequate numbers of patients. The effects, if any, on the pituitary-gonadal axis in premenopausal women are unknown. Caution should be exercised if an HMG-CoA reductase inhibitor is administered concomitantly with drugs that may decrease the levels or activity of endogenous steroid hormones, such as ketoconazole, spironolactone, and cimetidine. **CNS Toxicity** — Brain hemorrhage was seen in a female dog treated for 3 months at 120 mg/kg/day. Brain hemorrhage and optic nerve vacuolation were seen in another female dog that was sacrificed in moribund condition after 11 weeks of escalating doses up to 280 mg/kg/day. The 120 mg/kg dose resulted in a systemic exposure approximately 16 times the human plasma area-under-the-curve (AUC, 0-24 hours) based on the maximum human dose of 80 mg/day. A single tonic convulsion was seen in each of 2 male dogs (one treated at 10 mg/kg/day and one at 120 mg/kg/day) in a 2-year study. No CNS lesions have been observed in mice after chronic treatment for up to 2 years at doses up to 400 mg/kg/day or in rats at doses up to 100 mg/kg/day. These doses were 6 to 11 times (mouse) and 8 to 16 times (rat) the human AUC (0-24) based on the maximum recommended human dose of 80 mg/day. CNS vascular lesions, characterized by perivascular hemorrhages, edema, and mononuclear cell infiltration of perivascular spaces, have been observed in dogs treated with other members of this class. A chemically similar drug in this class produced optic nerve degeneration (Wallerian degeneration of retinogeniculate fibers) in clinically normal dogs in a dose-dependent fashion at a dose that produced plasma drug levels about 30 times higher than the mean drug level in humans taking the highest recommended dose. **Carcinogenesis, Mutagenesis, Impairment of Fertility** — In a 2-year carcinogenicity study in rats at dose levels of 10, 30, and 100 mg/kg/day, 2 rare tumors were found in muscle in high-dose females: in one, there was a rhabdomyosarcoma and, in another, there was a fibrosarcoma. This dose represents a plasma AUC (0-24) value of approximately 16 times the mean human plasma drug exposure after an 80 mg oral dose. A 2-year carcinogenicity study in mice given 100, 200, or 400 mg/kg/day resulted in a significant increase in liver adenomas in high-dose males and liver carcinomas in high-dose females. These findings occurred at plasma AUC (0-24) values of approximately 6 times the mean human plasma drug exposure after an 80 mg oral dose. *In vitro*, atorvastatin was not mutagenic or clastogenic in the following tests with and without metabolic activation: the Ames test with *Salmonella typhimurium* and *Escherichia coli*, the HGPRT forward mutation assay in Chinese hamster lung cells, and the chromosomal aberration assay in Chinese hamster lung cells. Atorvastatin was negative in the *in vivo* mouse micronucleus test. Studies in rats performed at doses up to 175 mg/kg (15 times the human exposure) produced no changes in fertility.



There was aplasia and aspermia in the epididymis of 2 of 10 rats treated with 100 mg/kg/day of atorvastatin for 3 months (16 times the human AUC at the 80 mg dose); testis weights were significantly lower at 30 and 100 mg/kg and epididymal weight was lower at 100 mg/kg. Male rats given 100 mg/kg/day for 11 weeks prior to mating had decreased sperm motility, spermatid head concentration, and increased abnormal sperm. Atorvastatin caused no adverse effects on semen parameters, or reproductive organ histopathology in dogs given doses of 10, 40, or 120 mg/kg for two years. **Pregnancy: Pregnancy Category X — See CONTRAINDICATIONS.** Safety in pregnant women has not been established. Atorvastatin crosses the rat placenta and reaches a level in fetal liver equivalent to that of maternal plasma. Atorvastatin was not teratogenic in rats at doses up to 300 mg/kg/day or in rabbits at doses up to 100 mg/kg/day. These doses resulted in multiples of about 30 times (rat) or 20 times (rabbit) the human exposure based on surface area (mg/m²). In a study in rats given 20, 100, or 225 mg/kg/day, from gestation day 7 through to lactation day 21 (weaning), there was decreased pup survival at birth, neonate, weaning, and maturity in pups of mothers dosed with 225 mg/kg/day. Body weight was decreased on days 4 and 21 in pups of mothers dosed at 100 mg/kg/day; pup body weight was decreased at birth and at days 4, 21, and 91 at 225 mg/kg/day. Pup development was delayed (rotorod performance at 100 mg/kg/day and acoustic startle at 225 mg/kg/day; pinnae detachment and eye opening at 225 mg/kg/day). These doses correspond to 6 times (100 mg/kg) and 22 times (225 mg/kg) the human AUC at 80 mg/day. Rare reports of congenital anomalies have been received following intrauterine exposure to HMG-CoA reductase inhibitors. There has been one report of severe congenital bony deformity, tracheo-esophageal fistula, and anal atresia (VATER association) in a baby born to a woman who took lovastatin with dextroamphetamine sulfate during the first trimester of pregnancy. LIPITOR should be administered to women of child-bearing potential only when such patients are highly unlikely to conceive and have been informed of the potential hazards. If the woman becomes pregnant while taking LIPITOR, it should be discontinued and the patient advised again as to the potential hazards to the fetus. **Nursing Mothers:** Nursing rat pups had plasma and liver drug levels of 50% and 40%, respectively, of that in their mother's milk. Because of the potential for adverse reactions in nursing infants, women taking LIPITOR should not breast-feed (see CONTRAINDICATIONS). **Pediatric Use:** Treatment experience in a pediatric population is limited to doses of LIPITOR up to 80 mg/day for 1 year in 8 patients with homozygous FH. No clinical or biochemical abnormalities were reported in these patients. None of these patients was below 9 years of age. **Geriatric Use:** Treatment experience in adults age ≥70 years with doses of LIPITOR up to 80 mg/day has been evaluated in 221 patients. The safety and efficacy of LIPITOR in this population were similar to those of patients <70 years of age.

ADVERSE REACTIONS: LIPITOR is generally well-tolerated. Adverse reactions have usually been mild and transient. In controlled clinical studies of 2502 patients, <2% of patients were discontinued due to adverse experiences attributable to atorvastatin. The most frequent adverse events thought to be related to atorvastatin were constipation, flatulence, dyspepsia, and abdominal pain. **Clinical Adverse Experiences:** Adverse experiences reported in ≥2% of patients in placebo-controlled clinical studies of atorvastatin, regardless of causality assessment, are shown in the following table.

Adverse Events in Placebo-Controlled Studies (% of Patients)					
BODY SYSTEM Adverse Event	Placebo N = 270	Atorvastatin 10 mg N = 863	Atorvastatin 20 mg N = 36	Atorvastatin 40 mg N = 79	Atorvastatin 80 mg N = 94
BODY AS A WHOLE					
Infection	10.0	10.3	2.8	10.1	7.4
Headache	7.0	5.4	16.7	2.5	6.4
Accidental Injury	3.7	4.2	0.0	1.3	3.2
Flu Syndrome	1.9	2.2	0.0	2.5	3.2
Abdominal Pain	0.7	2.8	0.0	3.8	2.1
Back Pain	3.0	2.8	0.0	3.8	1.1
Allergic Reaction	2.6	0.9	2.8	1.3	0.0
Asthenia	1.9	2.2	0.0	3.8	0.0
DIGESTIVE SYSTEM					
Constipation	1.8	2.1	0.0	2.5	1.1
Diarrhea	1.5	2.7	0.0	3.8	5.3
Dyspepsia	4.1	2.3	2.8	1.3	2.1
Flatulence	3.3	2.1	2.8	1.3	1.1
RESPIRATORY SYSTEM					
Sinusitis	2.6	2.8	0.0	2.5	6.4
Pharyngitis	1.5	2.5	0.0	1.3	2.1
SKIN AND APPENDAGES					
Rash	0.7	3.9	2.8	3.8	1.1
MUSCULOSKELETAL SYSTEM					
Arthralgia	1.5	2.0	0.0	5.1	0.0
Myalgia	1.1	3.2	5.6	1.3	0.0

The following adverse events were reported, regardless of causality assessment in patients treated with atorvastatin in clinical trials. The events in italics occurred in ≥2% of patients and the events in plain type occurred in <2% of patients.

Body as a Whole: Chest pain, face edema, fever, neck rigidity, malaise, photosensitivity reaction, generalized edema. **Digestive System:** Nausea, gastroenteritis, liver function tests abnormal, colitis, vomiting, gastritis, dry mouth, rectal hemorrhage, esophagitis, eructation, glossitis, mouth ulceration, anorexia, increased appetite, stomatitis, biliary pain, cheilitis, duodenal ulcer, dysphagia, enteritis, melena, gum hemorrhage, stomach ulcer, tenesmus, ulcerative stomatitis, hepatitis, pancreatitis, cholestatic jaundice. **Respiratory System:** *Bronchitis, rhinitis,* pneumonia, dyspnea, asthma, epistaxis. **Nervous System:** *Insomnia, dizziness,* paresthesia, somnolence, amnesia, abnormal dreams, libido decreased, emotional lability, incoordination, peripheral neuropathy, torticollis, facial paralysis, hyperkinesia, depression, hypesthesia, hypertonia. **Musculoskeletal System:** *Arthritis,* leg cramps, bursitis, tenosynovitis, myasthenia, tendinous contracture, myositis. **Skin and Appendages:** Pruritus, contact dermatitis, alopecia, dry skin, sweating, acne, urticaria, eczema, seborrhea, skin ulcer. **Urogenital System:** *Urinary tract infection,* urinary frequency, cystitis, hematuria, impotence, dysuria, kidney calculus, nocturia, epididymitis, fibrocystic breast, vaginal hemorrhage, albuminuria, breast enlargement, metrorrhagia, nephritis, urinary incontinence, urinary retention, urinary urgency, abnormal ejaculation, uterine hemorrhage. **Special Senses:** Amblyopia, tinnitus, dry eyes, refraction disorder, eye hemorrhage, deafness, glaucoma, parosmia, taste loss, taste perversion. **Cardiovascular System:** Palpitation, vasodilatation, syncope, migraine, postural hypotension, phlebitis, arrhythmia, angina pectoris, hypertension. **Metabolic and Nutritional Disorders:** *Peripheral edema,* hyperglycemia, creatine phosphokinase increased, gout, weight gain, hypoglycemia. **Hemic and Lymphatic System:** Ecchymosis, anemia, lymphadenopathy, thrombocytopenia, ptechia. **Postintroduction Reports:** Adverse events associated with LIPITOR therapy reported since market introduction, that are not listed above, regardless of causality assessment, include the following: anaphylaxis, angioneurotic edema, bullous rashes (including erythema multiforme, Stevens-Johnson syndrome and toxic epidermal necrolysis), and rhabdomyolysis.

OVERDOSAGE: There is no specific treatment for atorvastatin overdosage. In the event of an overdose, the patient should be treated symptomatically, and supportive measures instituted as required. Due to extensive drug binding to plasma proteins, hemodialysis is not expected to significantly enhance atorvastatin clearance.

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Forum

We received more letters concerning Kashmir than any other article in the September issue. An Illinois reader commented: "Both Pakistan and India are unstable, warring countries with nuclear capabilities. We need this conflict to be resolved peacefully, and the first step toward peace is knowing about the situation. That's what your article does."

Kashmir

Lewis M. Simons was able to capture the romance, mysticism, and tragedy that have become part of the daily life in Kashmir. To the hawks on both sides I have this to say: "An eye for an eye makes you blind, and when you are groping in the dark, it's easy to tumble into an abyss."

SIVAM RAJAGOPAL
Kuala Lumpur, Malaysia

I was taken aback to see the British Army in Northern Ireland described as a foreign army of occupation. The situation in Northern Ireland is an incredibly deep-rooted and complex issue in political, religious, economic, and social terms. Whilst I wholly agree that the Roman Catholic community in the province sees the army as one of occupation, the general Protestant community sees them as peacekeepers who cannot possibly be in occupation as Northern Ireland is in Britain.

ALAN MORGAN
Hedgerley Green, England

It is unfortunate that in this undeclared war that has so long been ignored by the West, it has taken the feeling of a nuclear threat to prompt action.

AL MARRO
Hilliard, Florida

Mr. Simons too quickly dismisses the Kashmiri freedom struggle as hopeless because no other country is inclined to intervene militarily. Moral suasion by the international community holds promise. The first step would be an insistence by the United States and the United Nations Security Council that the genuine and legitimate leadership of the people of Kashmir be included as an equal partner with India and Pakistan in any negotiations. No solution is feasible that does not command a Kashmiri consensus.

GHULAM NABI FAI
Executive Director, Kashmiri American Council
Washington, D.C.

It's chilling that an area of such great natural beauty can be the cradle of so much hatred and violence, with no end in sight. On some far-distant day, as our sun explodes into a supernova and Earth is reduced

to a hot cinder, Kashmiri Muslims and Hindus will doubtless draw their last tortured breaths while still at each other's throats.

EDWARD G. KORAN
Phoenix, Arizona

Around at Last

It was great to see the accounts of historic balloon flights. I wish you had chronicled another flight, which occurred in October 1934. That flight had Jean and Jeannette Piccard [Bertrand Piccard's great-uncle and great-aunt] aboard. In the U.S. one had to have a license to fly a balloon. Jeannette had more time than Jean, so she obtained the required license and was the pilot. Jean was listed as "aide." Jeannette Piccard was the first woman to reach 57,579 feet.

GEORGIANA T. McCONNELL
Nashville, Tennessee

The story mentioned how the pilots could jettison empty gas tanks from inside the capsule. Where were they jettisoned? Was the population of the site considered? Did anyone pick up these tanks, or were they just left as litter along the route?

PAMELA SAGE
Lansing, Michigan

The team carefully considered this issue and dropped the tanks only over remote areas of the ocean. They were designed to split open on impact and sink.

Something about the highest altitude parachute jump (page 48) doesn't seem quite right. If Captain Kittinger fell at more than 600 mph for 13 minutes, he would have to have jumped from 130 miles up, far greater than the 102,800 feet stated. So what's up? Does the 13 minutes include the time he spent drifting to Earth under the parachute?

ROB COCQUYT
Squamish, British Columbia

Captain Kittinger did not fall at 600 miles an hour for the entire distance. He reached his top speed—614 miles an hour—at 90,000 feet and then was slowed by the increasing density of the atmosphere.

Masai Passage to Manhood

Your article made me realize that a rite of passage is something that modern Western civilization lacks. Most cultures throughout the world have had a way for adolescents to pass into adulthood. There are the vision quests of Native Americans, the Jewish bar mitzvah, Hindu marriage ceremonies, and many others. Each sets a specific time in which a child becomes an adult. The lack of this in Western culture leaves most adolescents confused about where they stand in a society that doesn't really know where to place them. I know because I am a child still myself at 16, and I have seen the struggle my peers have been through.

NATHANIEL WOJTALIK
Crested Butte, Colorado

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A year ago I lived in Kenya for the summer and stayed with the Masai for some time. As a student, I was respected; I was not the average tourist to them. On one occasion two Masai men allowed me to help in the sacrifice of a young goat. After they killed it, they taught me how to make a drum of the dried skin. A night I will never forget: Under the plethora of stars the men started jumping and dancing. The next morning a young Masai warrior took off his necklace and earring and gave them to me as a sign of acceptance, since I had respected his culture.

MELISSA MOWRY
North Providence, Rhode Island

Olive Oil

The virtues of olive oil were appreciated by Thomas Jefferson, who stated, "The Olive is a tree the least known in America, and yet the most worthy of being known." During the 1770s he attempted the cultivation of olive trees at Monticello despite the inhospitable climate. Later he arranged for the introduction of about 500 olive plants to South Carolina and Georgia, which he cited among his life's accomplishments. After some early successes, he was disheartened that his efforts to establish olive orchards in America were unsuccessful. Even in his last years he expressed optimism that the few surviving trees would be multiplied through grafting—an optimism that was never fulfilled.

GREGORY A. CADA
Rocky River, Ohio

In 1933 I was enrolled in the Greek elementary school for boys in Famagusta, Cyprus, a British crown colony at that time. We were taught not to knock olives off their branches but to handpick them, because the next year's crop, in bloom at the time of harvest, would also be knocked off. "Black" oil, regarded as inferior to "green" oil, was rendered from mature olives.

R. GEORGE PIERIDES
Alexandria, Virginia

I once worked as a goldsmith for a master craftsman, an inventive genius who devised practical tools out of common household items. We used olive oil in the annealing process, which relaxed the brittle ingots we pulled through round dies to make gold wire. A thin layer of oil was rubbed on the metal ingot before it was sent through the 1250°F oven. This acted as an emollient for the taut surface of the gold, like a bath-oil soak does for tight muscles. Olive, a very stable oil, did not burn under such extreme heat. Now I see why it is such a pleasure to cook with. It retains its flavor even after overzealous sautéing!

SUZANNE M. KUHN
Plano, Texas

Hunting With Eagles

I have always enjoyed your articles and found them to be informative, but the photograph on pages 98-9 troubled me. It looks like there is a strap around the neck and a strap around the muzzle of

How many languages are spoken in Kenya?



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the fox, restraining the animal so it can't get away. This is not the way to demonstrate to your readers that the force of talons can rip apart a fox. I am not an animal rights activist but concerned when any photographer re-creates a situation that is intentionally cruel.

DONNA HARRISON
Pine River, Minnesota

The photographer did not tether the fox, nor did he request that it be tethered for this photograph. Capturing and restraining foxes to be used for hunting practice is common among this group of Kazakhs.

Rodeos

It is not fear or pain that motivates rodeo livestock but excitement and play. The livestock are trained professionals that know the rules of the game, play to win, and enjoy themselves doing it. Hurt or terrified animals would not make a sudden jump to the side, then sit and watch the cowboys helplessly rush past; they would not take victory laps. We have to credit them with some level of intelligence, purpose, and sense of play.

MARK CRISPIN
Bainbridge Island, Washington

Animals don't understand "entertainment"—they aren't actors. Their actions are a direct mirror of how they feel. If they are angered, frightened, or hurt, they lash out, hurting themselves or the rider. A "tickle" at the animal's abdomen is not going to send it into such a blind rage that it will kill. Only fear, pain, and stress would do that.

LYNNE HAWKINSON
Virginia Beach, Virginia

Rodeo is the only major competitive sport evolved from an occupation. Hence its origins run deeper than mere entertainment value. In the unforgiving environment of the 19th-century western plains, the ability to rope a steer and break a colt could have meant the difference between life and death. The devotion rodeo riders now bring to their violent and dangerous sport might be explained by the fact that the skills of the cowboy were passed down from a generation that depended on them for survival.

JOE MCELWEE
Drexel Hill, Pennsylvania

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DAVID SCHARF

■ EXPLORER, JANUARY 16

Uninvited Guests

Venture into a sinister universe that may be a little too close for comfort: the macabre world of parasites, creatures with an appetite for living flesh. In January's EXPLORER, photographer David Scharf, renowned for the images he conjures from powerful electron microscopes, captures mug shots of these sometimes deadly hitchhikers. Viewers may take comfort that the blood-sucking *Kroyeria carchariaeglauci* (above) resides only in the gills of certain sharks that offer virtual hotels for parasites. But parasites are all around us—even inside us—feeding, breeding, stopping at nothing to complete their life cycles. One master of reproduction, *Plasmodium*, causes malaria, which kills as many as 2.7 million people a year.

Transmitted through the saliva of mosquitoes, it replicates in the liver, invading red blood cells and claiming its next victim. "The Body Snatchers" takes you inside the Centers for Disease Control in Atlanta as scientists track this and other deadly parasites.

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Earth Almanac



Arctic Ice Traps Whales — and Bears Feast

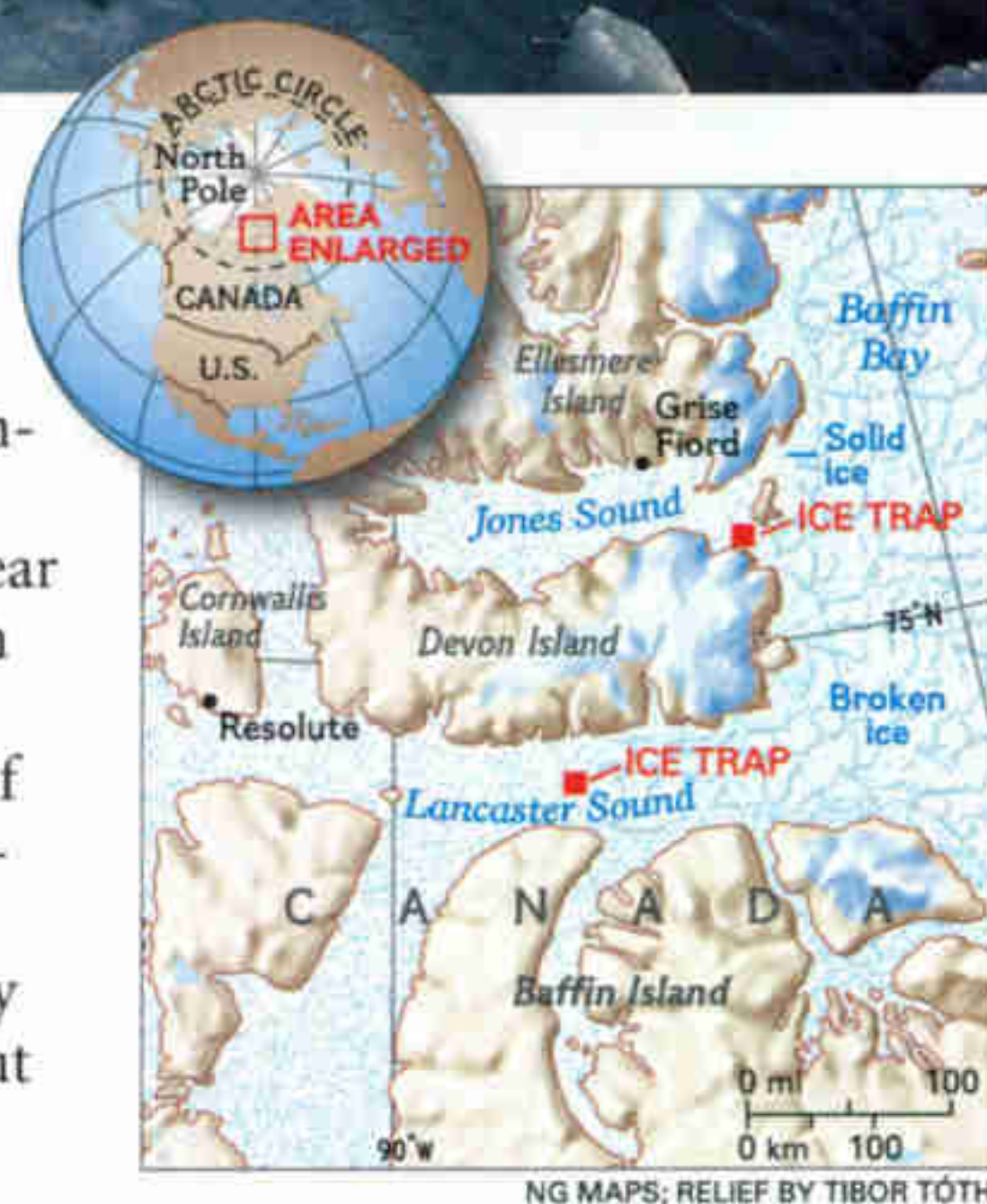
When ecologist Malcolm Ramsay looked down from his helicopter over frozen Lancaster Sound in the Canadian Arctic last May 30, he was astounded. “In five minutes we saw 25 polar bears,” he said. The bears had discovered a windfall: 40 beluga whales floundering in small holes in the sea ice. They were more than eight miles from open water, too far to swim under the ice without coming up for air. They were trapped.

“All the whales were badly scarred and wounded,” Ramsay

reports. “Pity the poor whales — polar bears above and Greenland sharks below.”

He tranquilized one male bear and two females, all bloated on beluga blubber. “The male weighed 1,037 pounds—one of the biggest I’ve ever handled—and the females were almost twice as heavy as they normally are in spring. The bears had put on so much weight that they could go without feeding for almost a year.” (See “Stalkers of the High Arctic,” January 1998.)

Examining satellite imagery of



the sea ice, Ramsay estimates that the ice trap formed between April 14 and April 23. In search of richer feeding waters, the belugas had swum from Baffin Bay into Lancaster Sound, breathing through cracks in the ice as it thawed. Then a big storm likely blew the cracks shut and trapped the whales for about 60 days. A second ice trap formed about a hundred miles north in Jones Sound, where more bears gorged on helpless belugas (left).



MALCOLM A. RAMSAY (TOP); OAKLEY COCHRAN

Tracking Device Rides Butterfly Wings

In Canada apollo butterflies have been successfully launched on a mission. The insects have been fitted with what may be the world's tiniest tracking tags—weighing 0.4 milligrams each—designed by University of Alberta biologist Jens Roland and his engineering colleagues. “We carry a small transmitter to send a signal that reflects off the butterflies’ tags. We can track them more than 150 feet away,” says Roland. His team marks letters on the wings to identify individuals when recaptured. The scientists are studying how apollo butterflies respond when stands of forest encroach upon their alpine meadow habitat.



NATALIE B. FOBES



THOMAS STRUHSAKER

Bonnet Macaque Males Hang Out

Sociable primates, six species of macaque monkeys live in India in groups ranging from four to a hundred members. While females usually remain with the group they were born into, male macaques eventually join other groups. Observing the way males interact, researcher Thomas Struhsaker of Duke University saw “enormous differences in male bonding behavior.” Among bonnet macaques (above) males of all ages often form subgroups and spend much time grooming each other. In contrast, rhesus macaque males usually avoid one another or show hostility within their social group. The other four species display in-between bonding behavior, Struhsaker says. Among them are the lion-tailed macaques, reduced to fewer than 4,000, all in southwestern India, where their habitat is threatened by expanding tea and coffee plantations.

TEXT BY JOHN L. ELIOT

Fingerprinting Rhinos by Foot

Poachers have reduced black rhinos to about 2,600; Zimbabwe has some 340 in guarded reserves. Because attaching radio collars stresses the animals and is expensive, Zoë Jewell and Sky Alibhai, founders of Zimbabwe-based Rhinowatch, have devised a hands-off tracking system using footprints.

A rhino foot (below top) seems generic, but each has quirks. When scouts in Hwange National Park find a rhino print, it is photographed with a digital camera, and its location is recorded with a global positioning system receiver. The data are fed into a computer, which marks and compares the print's landmark features with those of animals already recorded in the system. “We can identify which rhino made each print and monitor them,” the researchers say.



BOTH BY ZOË JEWELL AND SKY ALIBHAI, RHINOWATCH

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three feather bags

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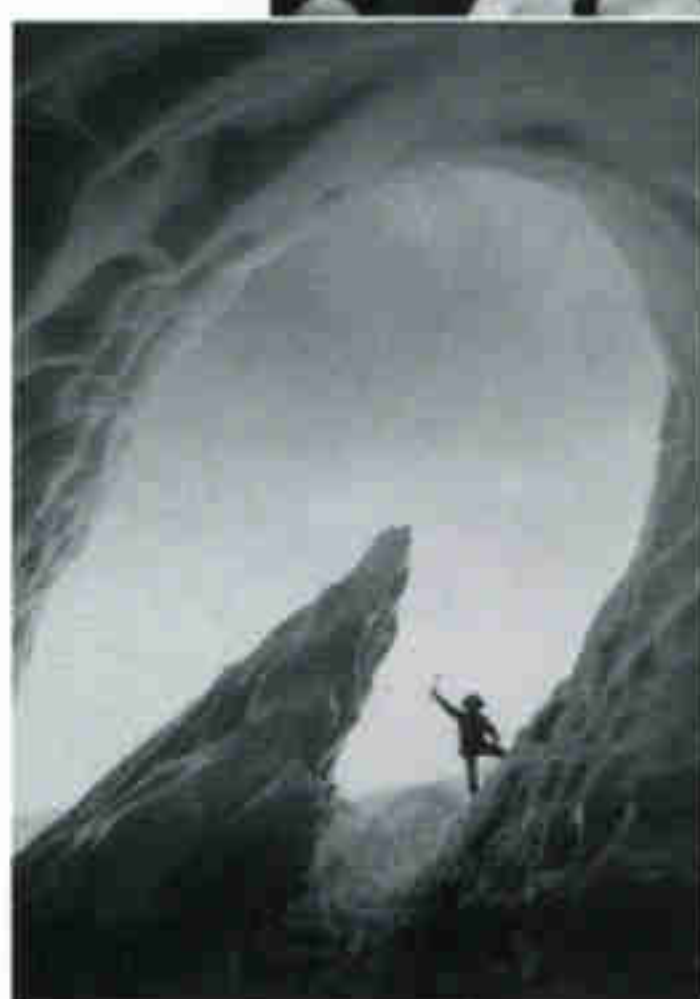
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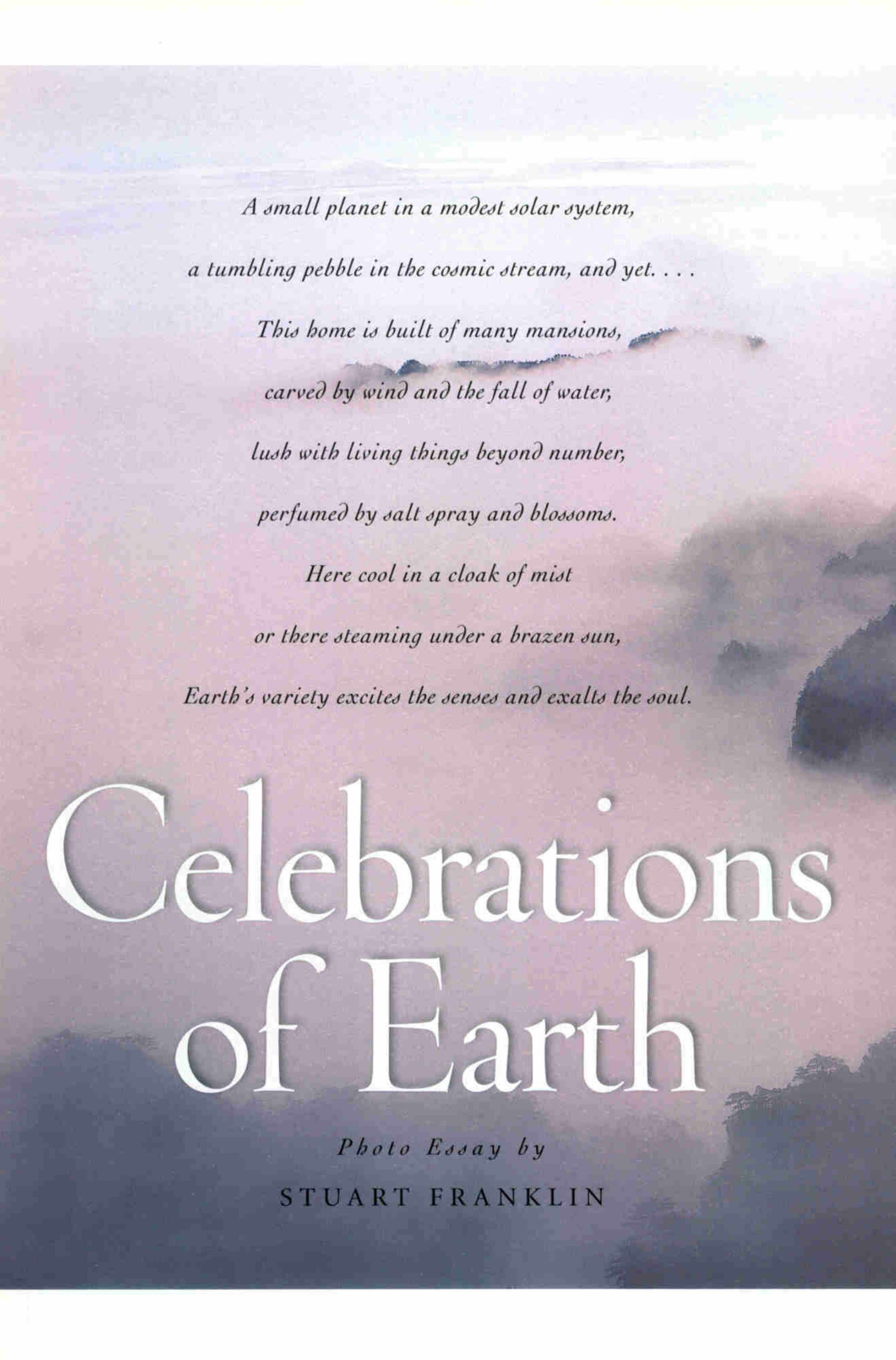
MARK THIESSEN, NGS STAFF, AND MARIA STENZEL

From the Editor

Happy New Year . . . New Century . . . New Millennium. As the once-in-a-millennium cover shows, humankind races into an exciting future. As a touchstone for the next thousand years we present in this issue a snapshot of our world. We see the beauty of our planet and its people, cross the most influential nation on Earth, welcome a new year in Tibet, and report the continuing search for extraterrestrial life.

One morning a few months ago the staff of NATIONAL GEOGRAPHIC magazine gathered in our courtyard for the first such family portrait in 112 years. They even gave me a paddle. So here we are, proud of our past and excited about our future. We're glad you're with us.

Bill Allen



*A small planet in a modest solar system,
a tumbling pebble in the cosmic stream, and yet. . . .*

*This home is built of many mansions,
carved by wind and the fall of water,
lush with living things beyond number,
perfumed by salt spray and blossoms.*

*Here cool in a cloak of mist
or there steaming under a brazen sun,*

Earth's variety excites the senses and exalts the soul.

Celebrations of Earth

Photo Essay by
STUART FRANKLIN



HUANG SHAN (YELLOW MOUNTAINS), SOUTHERN ANHUI PROVINCE, CHINA





BRYCE CANYON NATIONAL PARK, SOUTHERN UTAH, UNITED STATES



W*e section soil into paddies, gardens, orchards,*

then scatter seeds, and set cuttings, and wait.

Out of sunshine, rain, and air,

obliging nature conjures leaf and root, grain and fruit—

draping our tidy, bounded plots with green exuberance.



TERRACED RICE FIELDS, BALI, INDONESIA



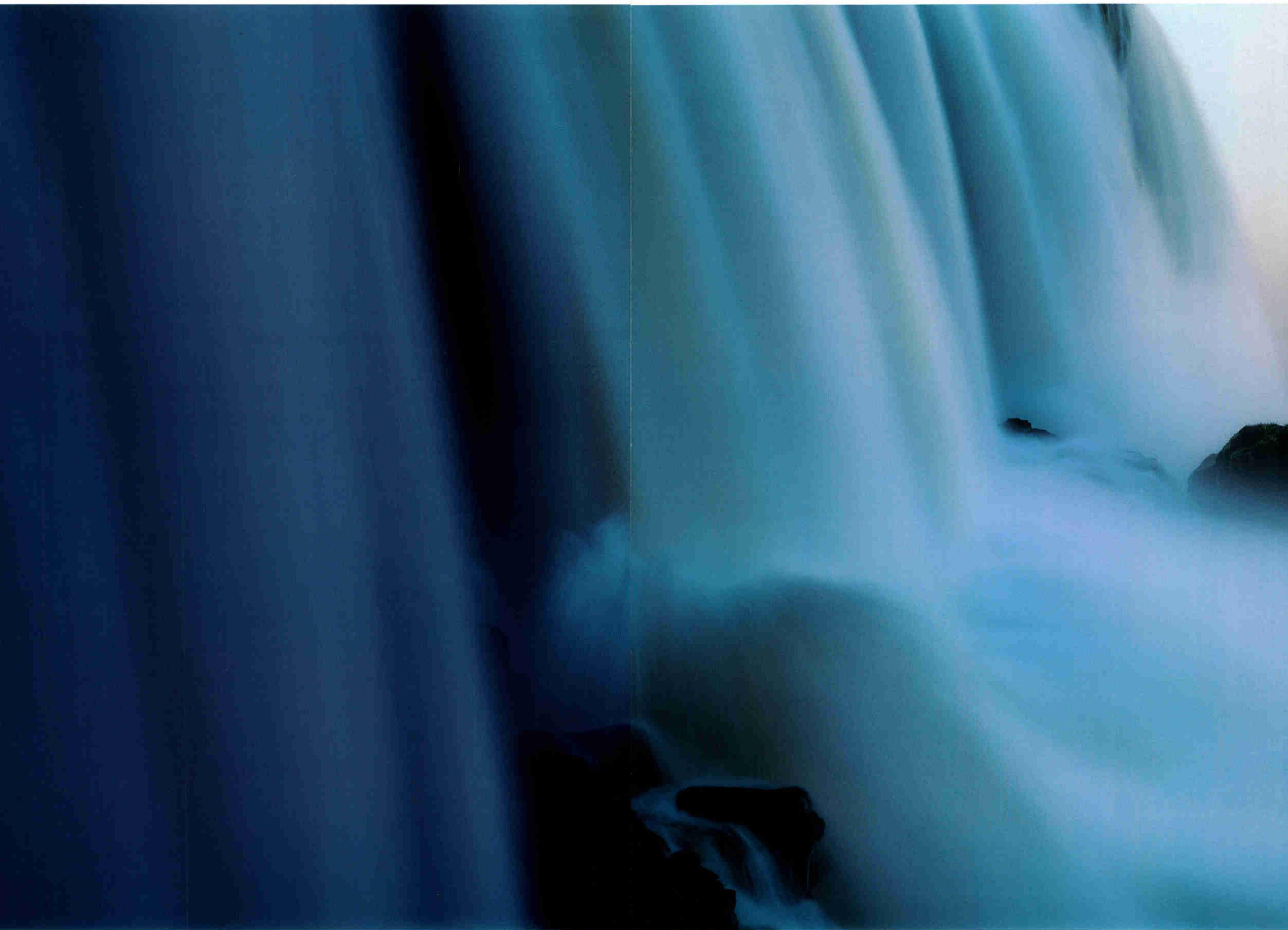


MINERAL DEPOSITS, LAKE NATRON, NORTHERN TANZANIA





RUB AL KHALI DESERT, NEAR THE SHAYBAH OIL FIELD, SOUTHEASTERN SAUDI ARABIA



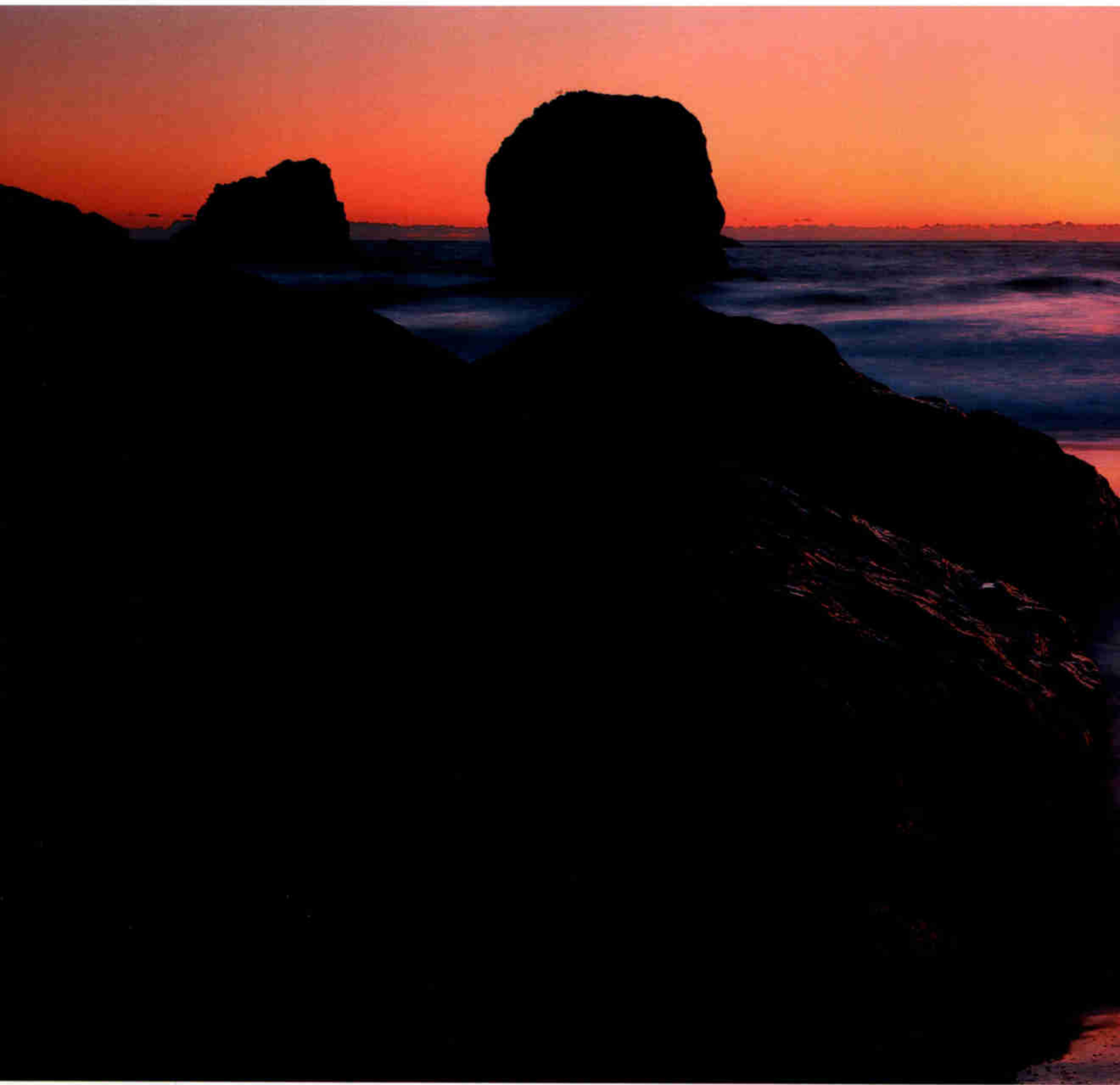


IGUAÇU FALLS, AT THE BORDERS OF BRAZIL, PARAGUAY, AND ARGENTINA



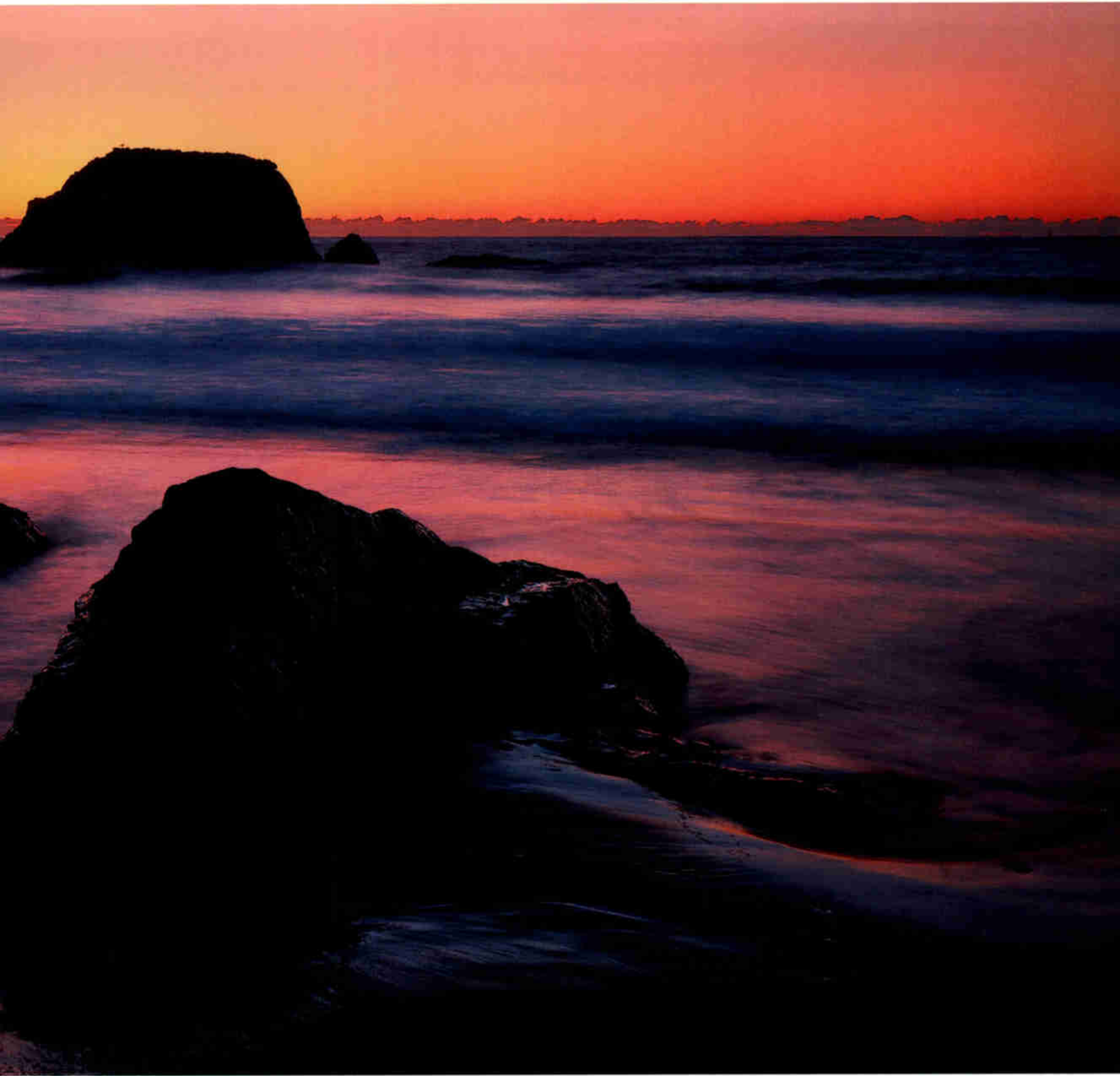


MONTEVERDE CLOUD FOREST PRESERVE, NORTHERN COSTA RICA



T*he sun retreats below the rim of the turning world,
trailing golden pennants across the curling waves.
At land's end we may dream of passageways into the deep,
invitations to explore Earth's halls and chambers
hidden beneath the sea. □*

Photographer STUART FRANKLIN lives in Oxford, England.



OREGON COAST, SOUTH OF THE COLUMBIA RIVER, UNITED STATES

Once we realized that Earth was not the center of the universe, we began scouring the skies for company. So far we've found nothing to prove that alien life exists, but science has uncovered new prospects even as it dismissed others. We no longer expect Martians to attack from the night sky, but we may yet find signs of life on the red planet—or on Jupiter's moon Europa or distant planets. Why the hope? Life is far hardier than we thought.

L I F E B E Y O N D E A R T H

BY JOEL ACHENBACH PHOTOGRAPHS BY PETER ESSICK



A manned Mars mission is still more than a decade away, but NASA's not sitting on its hands—it's improving them. This prototype suit is engineered for limb and finger flexibility, making it easier to find and bag rocks with the best potential for evidence of past life.

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TOO FAR TO PHONE HOME

Millions believe in alien visitors like this prop at the International UFO Museum and Research Center in Roswell, New Mexico. They'd have to be some fast, long-living ETs. Even at ten million miles an hour—about 250 times faster than our fastest spacecraft travels—a trip from the nearest star system would take 300 years.





S

OMETHING ASTONISHING has happened in the universe. There has arisen a thing called life—a flamboyant, rambunctious, gregarious form of matter, qualitatively different from rocks, gas, and dust, yet made of the same stuff, the same humdrum elements lying around everywhere.

Life has a way of being obvious—it literally scampers by, or grows, or curls up on the windowsill—and yet it's notoriously difficult to define in absolute terms. We say that life replicates. Life uses energy. Life adapts. Some forms of life have developed large central processing networks. In at least one instance, life has become profoundly self-aware.

And that kind of life has a big question: What else is alive out there?

There may be no scientific mystery so tantalizing at the brink of the new millennium and yet so resistant to an answer. Extraterrestrial life represents an enormous gap in our knowledge of nature. With instruments such as the Hubble Space Telescope, scientists have discovered a bewildering amount of cosmic turf, and yet they still know of only a single inhabited world.

We all have our suppositions, our scenarios. The late astronomer Carl Sagan estimated that there are a million technological civilizations in our galaxy alone. His more conservative colleague Frank Drake offers the number 10,000. John Oro, a pioneering comet researcher, calculates that the Milky Way is sprinkled with a hundred civilizations. And finally there are

The simple truth: Extraterrestrial life,



Scientists interested in extraterrestrial life don't go to Roswell; they go to harsh environments where conditions resemble those of early Mars. In the Canadian high Arctic, warm, salty springs support bacterial life in a frigid land of 1,800-foot-thick permafrost.

skeptics like Ben Zuckerman, an astronomer at UCLA, who thinks we may well be alone in this galaxy if not in the universe.

All the estimates are highly speculative. The fact is that there is no conclusive evidence of any life beyond Earth. Absence of evidence is not evidence of absence, as various pundits have wisely noted. But still we don't have any solid knowledge about a single alien microbe, a solitary spore, much less the hubcap from a passing alien starship.

Our ideas about extraterrestrial life are what Sagan called "plausibility arguments," usually shot through with unknowns, hunches, ideologies, and random ought-to-bes. Even if we convince ourselves that there must be life out there, we confront a second problem,

found thriving on our own planet in bizarre, hostile environments. If microbes can live in the pores of rock deep beneath the earth or at the rim of a scalding Yellowstone spring, then they might find a place like Mars not so shabby.

Mars is in the midst of a full-scale invasion from Earth, from polar landers to global surveyors to rovers looking for fossils. A canister of Mars rocks will be rocketed back to Earth in the year 2008, parachuting into the Utah desert for scrutiny by scientists in a carefully sealed lab. In the coming years probes will also go around and, at some point, into Jupiter's moon Europa. That icy world shows numerous signs of having a subsurface ocean—and could conceivably harbor a dark, cold biosphere.

The quest for an alien microbe is supplemented by a continuing effort to find something large, intelligent, and communicative. SETI—the Search for Extraterrestrial Intelligence—has not yielded a confirmed signal from an alien civilization in 40 years of experiments, but the signal-processing technology grows more sophisticated each year. The optimists

by definition, is not conveniently located.

which is that we don't know anything *about* that life. We don't know how truly alien it is. We don't know if it's built on a foundation of carbon atoms. We don't know if it requires a liquid-water medium, if it swims or flies or burrows.

Despite the enveloping nebula of uncertainties, extraterrestrial life has become an increasingly exciting area of scientific inquiry. The field is called exobiology or astrobiology or bioastronomy—every few years it seems as though the name has been changed to protect the ignorant.

Whatever it's called, this is a science infused with optimism. We now know that the universe may be aswarm with planets. Since 1995 astronomers have detected at least 22 planets orbiting other stars. NASA hopes to build a telescope called the Terrestrial Planet Finder to search for Earth-like planets, examining them for the atmospheric signatures of a living world. In the past decade organisms have been

figure it's only a matter of time before we tune in the right channel.

No one knows when—or if—one of these investigations might make a breakthrough. There's a fair bit of boosterism surrounding the entire field, but I'd bet the breakthrough is many years, if not decades, away. The simple truth: Extraterrestrial life, by definition, is not conveniently located.

But there are other truths that sustain the search for alien organisms. One is that, roughly speaking, the universe looks habitable. Another is that life radiates information about itself—that, if nothing else, it usually leaves a residue, an imprint, an echo. If the universe contains an abundance of life, that life is not likely to remain forever in the realm of the unknown.

Contact with an alien civilization would be an epochal and culturally challenging event, but exobiologists would settle gladly for the discovery of a tiny fossil, a mere remnant of extraterrestrial biochemistry. One example. One data point to add to the one we have—Earth life. That's what we need to begin the long process of putting human existence in its true cosmic context.

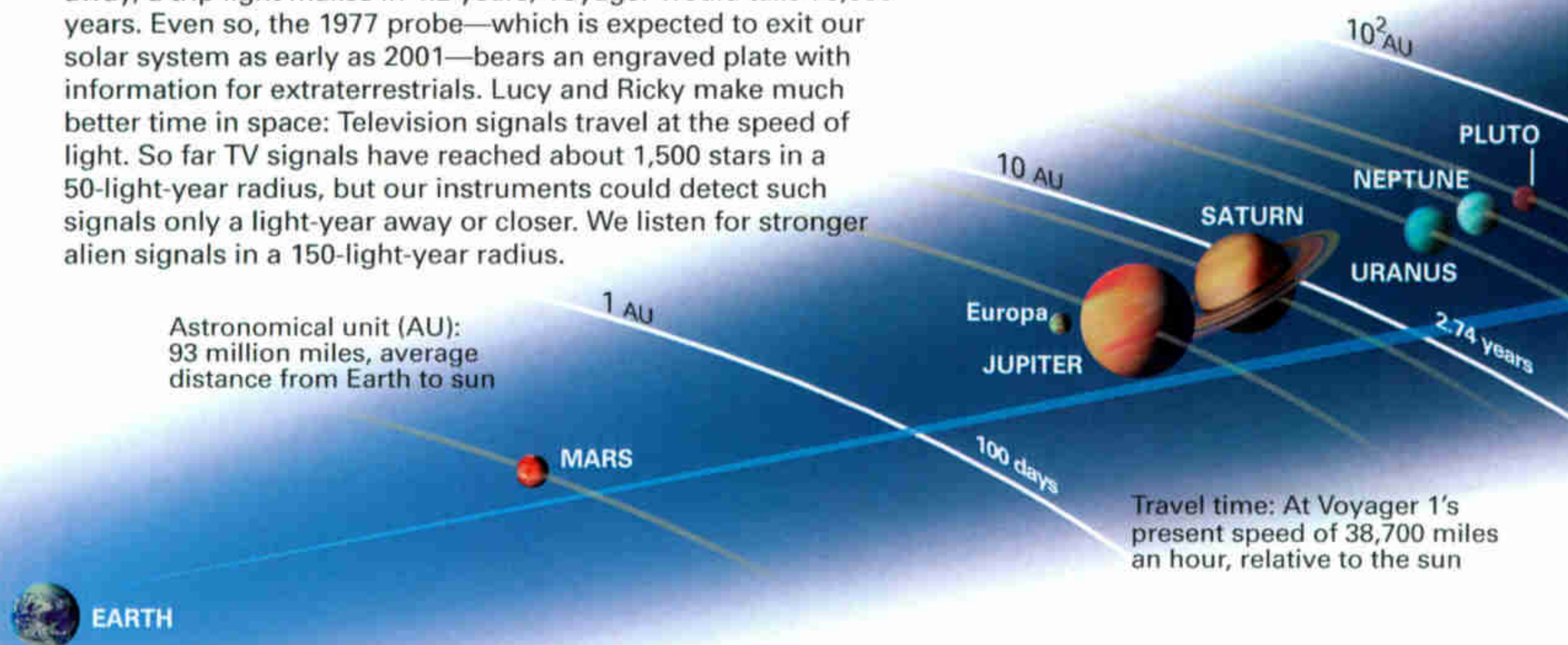
JOEL ACHENBACH, a journalist for the *Washington Post*, recently wrote *Captured by Aliens: The Search for Life and Truth in a Very Large Universe*. PETER ESSICK photographed "Mars on Earth" for the July 1999 issue.

What's our reach?

From four billion miles away Earth seems distant in this image from Voyager 1, but in space that's a jaunt. Our solar system's closest neighbor, Proxima Centauri, is 25 trillion miles away, a trip light makes in 4.2 years; Voyager would take 70,000 years. Even so, the 1977 probe—which is expected to exit our solar system as early as 2001—bears an engraved plate with information for extraterrestrials. Lucy and Ricky make much better time in space: Television signals travel at the speed of light. So far TV signals have reached about 1,500 stars in a 50-light-year radius, but our instruments could detect such signals only a light-year away or closer. We listen for stronger alien signals in a 150-light-year radius.



NASA



EXO BIOLOGISTS GO to the worst places on Earth, or at least the most extreme—the driest, coldest, most Mars-like or Europa-like environments they can find.

If you want to track down the exobiologist Jack Farmer from Arizona State University, you look for him in Death Valley, on the shores of nearby Mono Lake, or swimming beneath the ice shelf in Antarctica. If seeking Chris McKay, you might check out the Atacama Desert of Chile or some island north of the Arctic Circle.

The place to find Penny Boston is in the nastiest cave imaginable. I tagged along with Boston on one of her trips to a wet, bat-ridden cave in southern Mexico called Villa Luz. Boston has been studying the microbes that thrive there—in environments where a human being not wearing a gas mask would perish.

“All my life I’ve wanted to cross the cosmos, go to other planets,” says Boston. “This is probably as close as I’ll get at my age.”

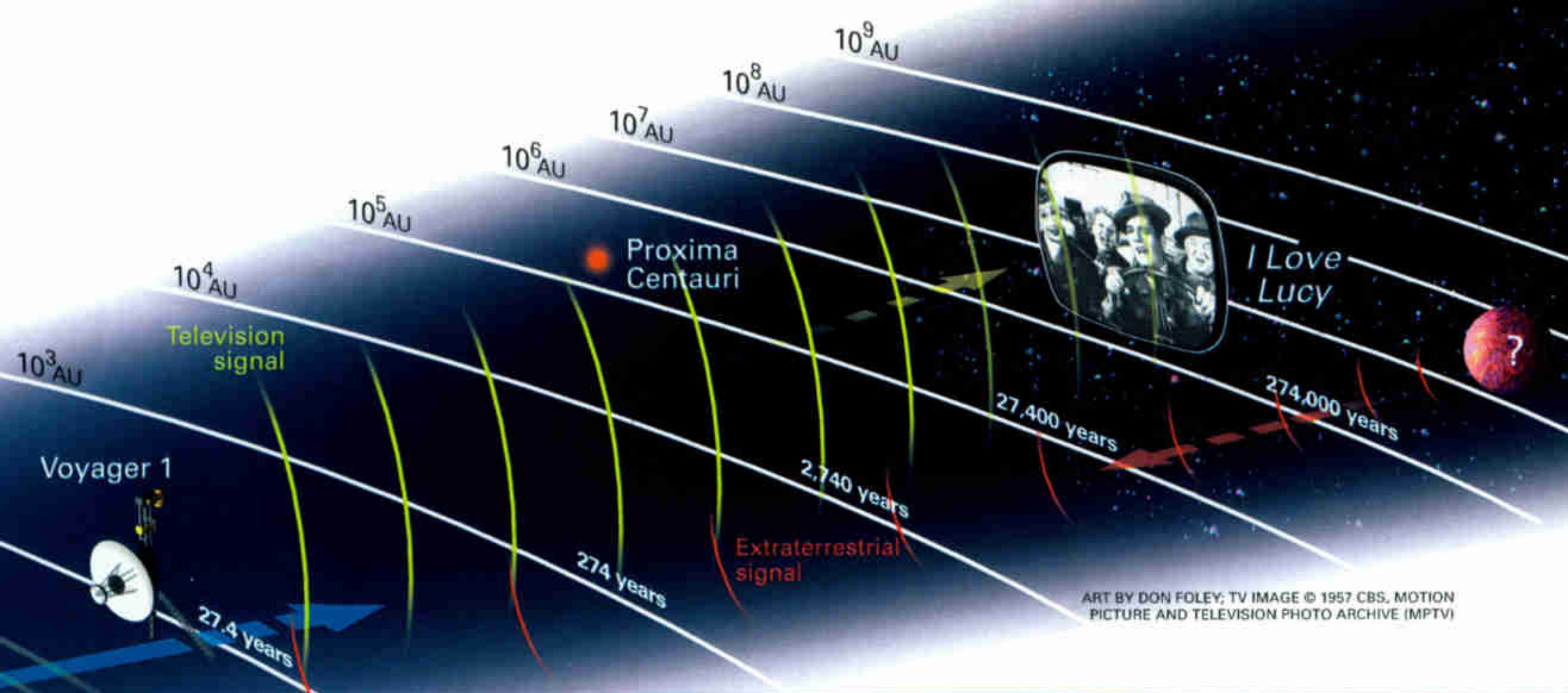
Boston and her friend Diana Northup, a librarian and cave biologist in New Mexico, are undeterred by the face-smashing gas masks they must wear or by the constant wetness, the darkness, the bats, or the slight possibility that

a belch of carbon monoxide would kill everyone. Nor are they overly concerned about the various threats of malaria and dengue fever and whatever other exotic diseases they might pick up here. Before we entered Villa Luz, I asked if there was any danger of encountering an unknown, Ebola-like pathogen. “We think it’s moderately unlikely,” Boston said.

The cave floor was covered with water of varying depths and no transparency, and we walked gingerly so as to avoid discovering unmapped deep water. By caving standards, though, this was a walk in the park—no ropes required, just some crawling and scrambling through low-ceilinged passages.

Eventually we reached the deepest, largest chamber, known as the Great Hall. Midges flitted, spiders spun webs, bats zagged and zigged just over our heads, emitting their high-pitched sonar. Red rock walls were covered with green slime, black muck, gooey white gypsum paste, and limestone in the process of being dissolved by sulfuric acid.

Just as I was thinking how much this cave resembled the human nasal cavity, we came to the snottites (Boston is lobbying to have the word recognized as a scientific term).



Nearly 40 years have passed since astronomer Frank Drake penned his equation gauging the potential number of planets with technologically advanced life, which he puts at 10,000 within our galaxy alone. Scientists have yet to find any signals from distant civilizations, but “the power of our search system is a hundred trillion times what it was 40 years ago,” he says.

Snottites are gelatinous structures formed by microbial wastes. They dangle from the ceiling. Boston and her team have been measuring their growth, trying to understand the metabolism of the microbes and their long-term effect on the geology of the cave. Dry weather since her last visit seemed to have inhibited the growth of the structures.

Mike Spilde, another member of the team, splashed over to where I’d been inspecting

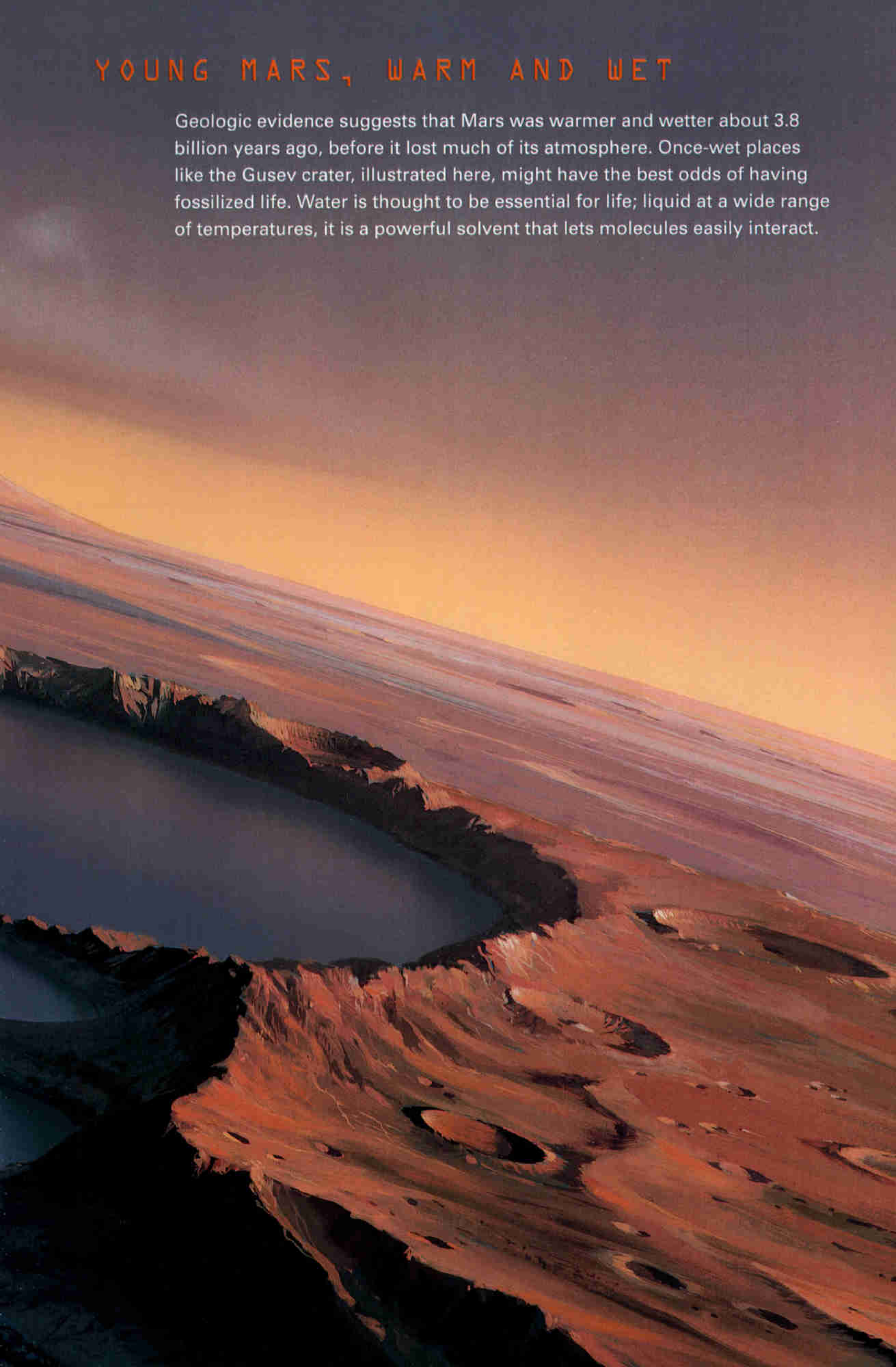
a water bug whose shell was covered with eggs. He reached into a spring burbling from under a rock and pulled out some gray wads the consistency of cooked cabbage. These are known, in keeping with the theme of the place, as phlegm balls. They are vibrant microbial communities, not clinging to life in a narrow niche but proliferating in it, replicating up a storm.

Taking a break back on the surface, Boston placed some of her cave work in context.



YOUNG MARS, WARM AND WET

Geologic evidence suggests that Mars was warmer and wetter about 3.8 billion years ago, before it lost much of its atmosphere. Once-wet places like the Gusev crater, illustrated here, might have the best odds of having fossilized life. Water is thought to be essential for life; liquid at a wide range of temperatures, it is a powerful solvent that lets molecules easily interact.



FOLLOW THE MARTIAN WATER



DID MARS HAVE A BLUE SKY?

Mars and Earth were more similar when they were less than a billion years old. An artist's rendition of Mars then looks much like Earth: Both planets had liquid water, kept warm by atmospheres thick in CO_2 . Life arose quickly on Earth during this period. Even if Mars remained lifeless, we stand to learn a lot about why life does or doesn't begin.

LIFE IN THE HABITABLE ZONE

Scientists believe that star systems have habitable zones, within which the surfaces of planets can sustain liquid water and thus life. In our system this zone has been moving outward as the sun gets hotter. Mars is within the zone, but its atmosphere—only one percent as thick as Earth's—can't hold in nearly enough heat to keep water liquid.

A RIVER RAN THROUGH IT

A mile and a half wide, the Nanedi Vallis canyon may be the best evidence yet that Mars had regularly running water in the past. It meanders like a river and has in its lower canyon, at top, a narrow channel suggesting a continuous water flow.

ABOVE FROM LEFT: STARLEY THOMPSON, COMPLEX SYSTEMS RESEARCH; ART BY CAROLYN P. SUMMERVILLE, NGS STAFF; MALIN SPACE SCIENCE SYSTEMS (MSSS)/NASA



“We have discovered”—she means scientists in general—“organisms thriving in environments harsh to us but essential to them. It broadens your perspective. We all suffer to some extent from ‘expertitis’ in science. It’s good for your soul, and good for your intellect, and good for your work to have your imagination stretched, to be open to the possibilities.”

The most tantalizing possibility is that the universe hums with life and that in the coming centuries we will find it. An exobiologist’s abiding optimism is fired by the knowledge that living things are primarily constructed of hydrogen, nitrogen, carbon, and oxygen—the four most common chemically active elements in the universe. And life is inextricably interwoven with nonlife; not even the sharpest razor can perfectly slice them apart.

We also know that a functioning ecosystem does not require sunlight or photosynthesis. In the early 1990s researchers found that the basaltic rock deep beneath Washington State contains an abundance of microbes totally cut off from the photosynthetic world. Even more

complex life can adapt to hostile places. When scientists in the deep-sea submersible *Alvin* went tooling around the mid-ocean ridges, they found hot vents covered with shrimp and mouthless tube worms.

What remains unknown is whether life can survive over time in narrow ecological niches on largely barren worlds. Could life survive in aquifers far below the harsh surface of Mars? What could endure the cold, dark environment of Europa’s hypothesized ocean? Can an alien world have just a little bit of life, or are biospheres an all-or-nothing proposition?

The cave at Villa Luz, as remote as it is, does not exist in isolation. It is a small, connected piece of a world that riots with life.

AS SCIENTISTS STRUGGLE to find a trace of life somewhere else in the universe, there exists for many people a more dramatic situation, one in which extraterrestrial life isn’t microbial and slimy but rather intelligent, technological, and lurking in our midst. The believers in these



Though the Viking lander found no signs of life on Mars in 1976, the results were not definitive. “You could land Viking on some spots on Earth and find no life,” says Jack Farmer, an exobiologist who tries to identify the best places to find remnants of Martian life—where evaporating water left mineral deposits that might have fossils. In Death Valley (left) he and a colleague use a spectrometer to confirm aerial images of mineral deposits. This will help Mars orbiters identify prime landing sites. Meanwhile, a robotic plane is being designed to take spectrometer readings of Martian canyon walls.



O. LOUIS MAZZATENTA

NO ROCK-SOLID SIGNS OF LIFE



The Martian meteorite that shook the Earth—ALH84001—now sits quietly in Houston. Old enough to coexist with early Martian life, the

4.5-billion-year-old rock was found in Antarctica 13,000 years after it landed. In 1996 a team of scientists broke the news: Four lines of evidence suggested that the rock once hosted microbial life. But the scientific community found the evidence inconclusive. For instance, the wormlike structures that looked like microbial fossils (right)

could have been created inorganically. And when some minerals resembling bacterial by-products were examined with an electron microscope (left), their microstructures indicated they were formed at temperatures too high for life.



JOHN BRADLEY, MVA, AND GEORGIA INSTITUTE OF TECHNOLOGY (LEFT); NASA

aliens are not likely to be convinced that ETs are a bogus phenomenon. An ability to elude detection and confirmation, particularly by mainstream thinkers, is a presumed characteristic of the Visitors.

Having dropped in on a couple of UFO conventions and visited Roswell, New Mexico, and its UFO museum, I've come to the conclusion that it's not possible to win an argument about space aliens. True believers and skeptics rarely go over to the other side. I think it's fair to say, however, that flying-saucer aliens lack scientific stature. If they insist on being so jumpy, if they insist on abducting people in the middle of the night when no one else can verify their presence, then they have no right to enter a reputable natural history museum.

But neither are people who believe in the UFO narrative—which generally is dated to the 1947 sighting of some flying “disks” near Mount Rainier in Washington State—necessarily irrational, much less crazy, as they are sometimes depicted. Most people operate from the same instinct, which is to know the truth about the universe. That so many people would adopt a theory of aliens utterly contrary to that of mainstream science (and that of, among agencies, the U.S. Air Force, which spent 22 years investigating UFO reports) is a reminder of the special attraction of the idea of extraterrestrial life.

As many writers have noted, aliens are, for some people, the secular equivalent of angels and demons and ghostly spirits. The aliens are an extrapolation of modern astronomy and engineering (big universe, fast rocket ships), but they also possess some ancient urge to come to Earth and mess with human beings. What makes them so intriguing is that even scientists will concede that alien beings could very well be out there somewhere. Therefore the scenario in which they come to Earth requires only some imagination about transportation.

Many scientists don't wonder why aliens are buzzing the Earth in flying saucers—they wonder why they aren't. In 1950 Enrico Fermi, a physicist, asked some of his colleagues a question that would become famous: Where is everybody? Humans could theoretically colonize the galaxy in a million years or so, and if they could, astronauts from older civilizations could do the same. So why haven't

they come to Earth? This is known as the Fermi paradox.

Could it be that they're observing us but not interfering? (The zoo hypothesis.) Did they come and leave artifacts and get bored and go away? (This is the “ancient astronauts” idea that posits the aliens as builders of pyramids and so forth.) Or could it be that for all intelligent species, interstellar travel is too expensive and time-consuming? (It's just less than 25 trillion miles from Earth to the nearest star beyond the sun.)

Or could it be possible that, at least in our part of the galaxy, the most technologically advanced species is the one right here on Earth?



OUR CONTEMPORARY CULTURE did not invent this idea of life beyond Earth. The alien is a Hollywood stock character but not a Hollywood creation. More than 2,000 years ago the Greek philosopher Metrodorus of Chios wrote, “It is unnatural in a large field to have only one shaft of wheat, and in the infinite Universe only one living world.” Four centuries ago Giordano Bruno was burned at the stake in part because he believed that there were inhabited worlds throughout the cosmos. Astronomers like Christian Huygens supplemented their purely scientific work with treatises on the characteristics of life beyond Earth. Huygens felt, for example, that aliens would probably have hands, like humans.

Missing from the debate, typically, was the one ingredient of a truly persuasive argument: Evidence. That seemed to change with the apparent discovery of the Martian canals. In 1877 Giovanni Schiaparelli, an Italian astronomer, found what he called *canali*, or channels, on the surface of the planet. The American astronomer Percival Lowell and a few colleagues took the idea from there.

In the final years of the 19th century, Lowell, using a new telescope he built near Flagstaff, Arizona, revealed the discovery of hundreds of canals and argued that these were the artificial creations of an intelligent Martian civilization. In fact, he wrote, the Martians would certainly have to be superior to us. He reasoned that their globe-spanning engineering projects were far beyond our own capabilities and that the ability of a race of creatures to live in harmony over the whole of a planet

ARE WE ALONE?

A human history



Fifth century B.C.
Epicurus and other Greek philosophers argue that the universe is infinite and has countless populated worlds.



1609 Galileo turns a telescope skyward and agrees with Copernicus: Earth circles the sun—it is not the center of the universe.

1951 The Day the Earth Stood Still presents aliens as forceful benefactors, here to prevent Earthlings from spreading their warlike ways.



1965 Mariner 4 shows that Mars's surface is pocked with craters but not a single canal.



1969 Neil Armstrong and Buzz Aldrin become the first to walk on the moon. Armstrong is reflected here in Aldrin's visor.

Wow!

	1	
6	2	
1	2	4
1	Q	1
2	U	1
5	J	1
5	1	1
	1	4
1	3	
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	4	
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1977 "Wow!" writes a researcher when he finds a radio signal that looks artificial in origin, but it never repeats.

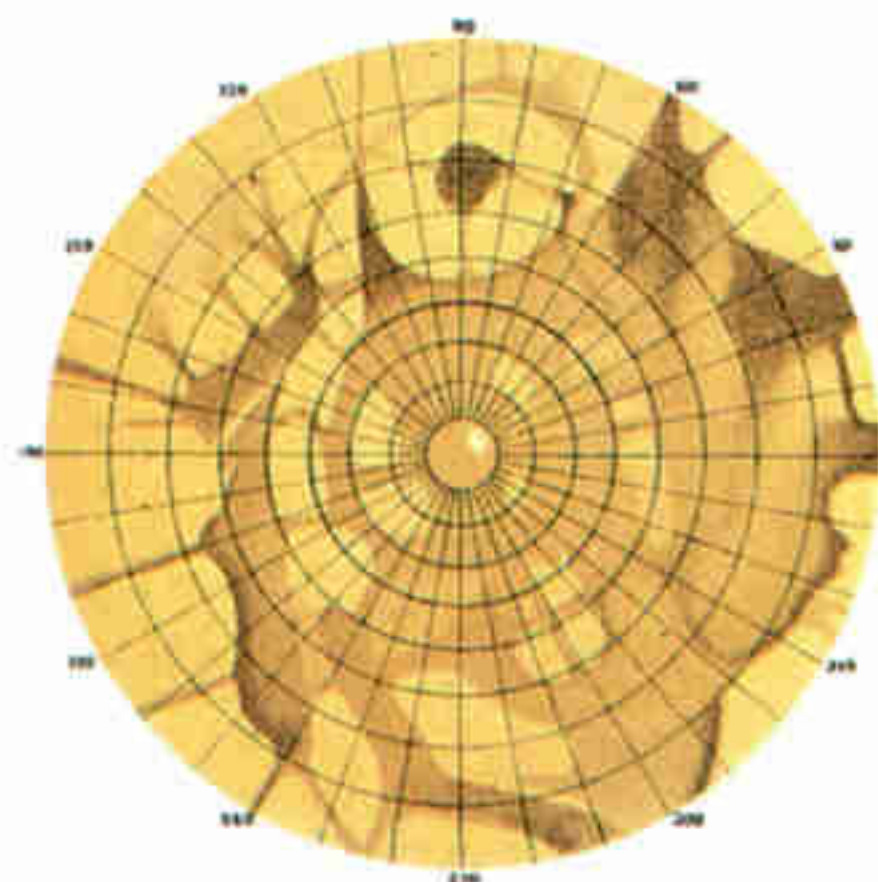


1982 E.T. takes the world by storm as a benevolent, misunderstood extraterrestrial.



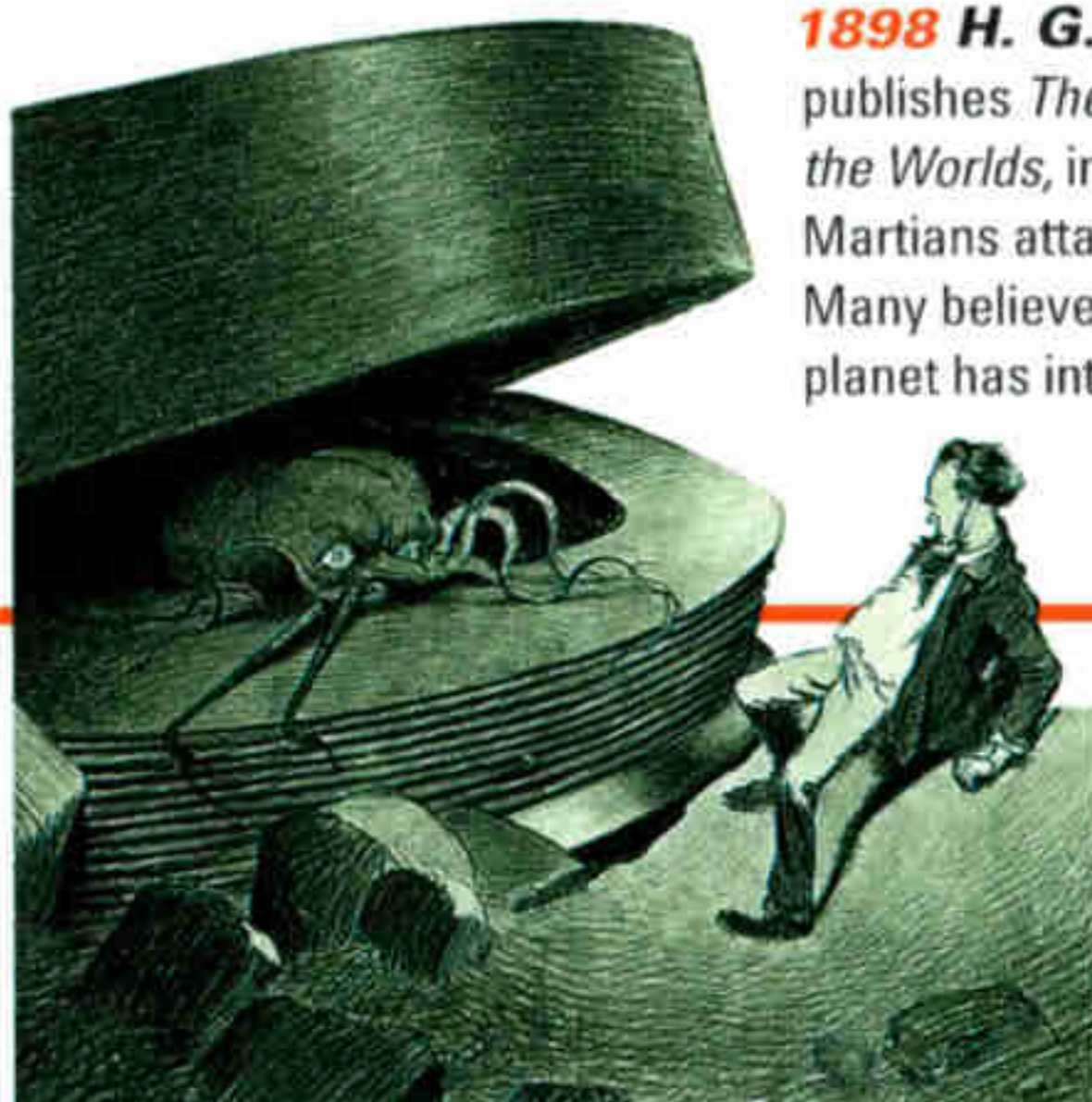
1976 A Viking orbiter photo of Mars's surface contains a face-like feature. Some speculate it was made by ancient Martians.

of wondering what or who is out there



1877 Italian astronomer

Giovanni Schiaparelli thinks he sees a network of straight lines on Mars, which he calls *canali*, or channels.

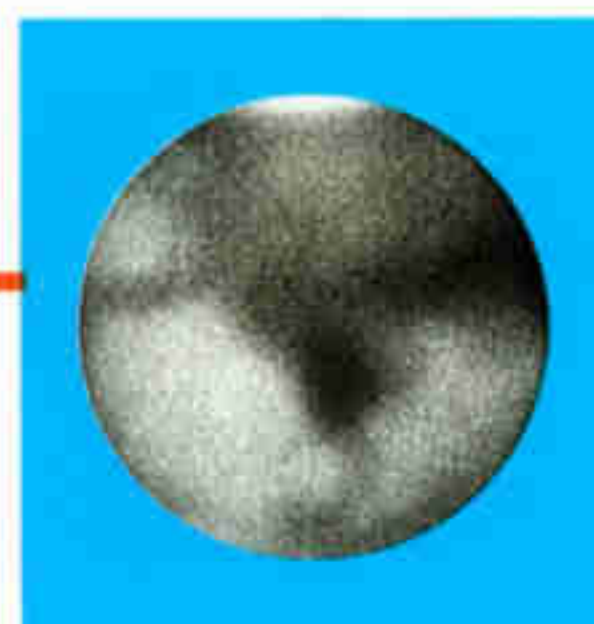


1898 H. G. Wells

publishes *The War of the Worlds*, in which Martians attack Earth. Many believe the red planet has intelligent life.

1907 Percival

Lowell photographs Mars to bolster his theory that it is home to intelligent creatures who built water canals.



WHERE IS EVERYBODY?

1950 Enrico Fermi asks his scientific colleagues: If there are so many advanced civilizations out there, where is everybody? The implication of the Fermi paradox: We are alone.



1993 The X-Files stokes fantasies of alien visitors and government cover-ups.



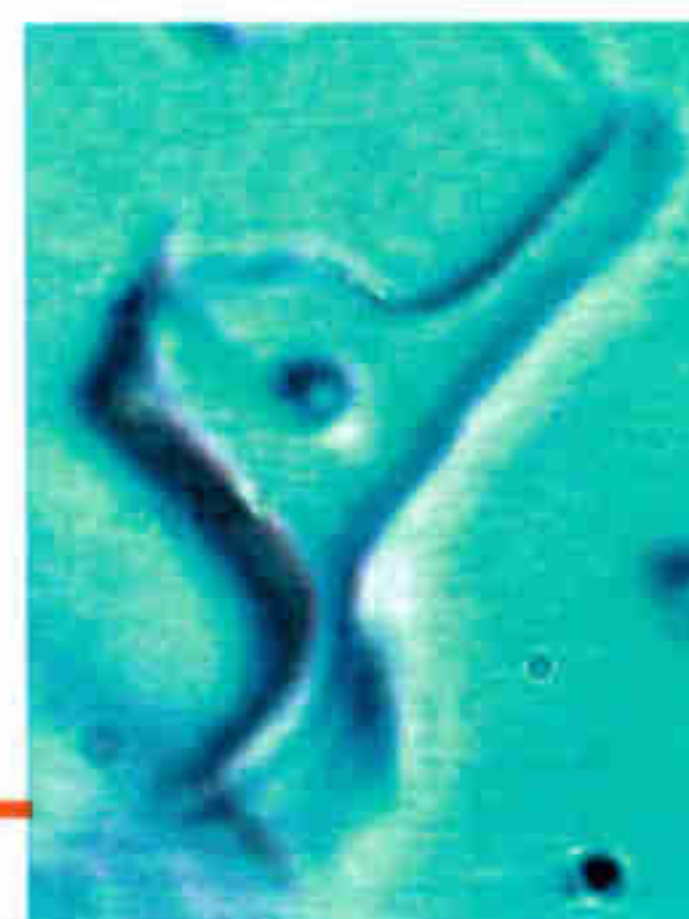
1939 NATIONAL GEOGRAPHIC

says Mars may have vegetation, but it is "extremely doubtful that there are any 'Martians' in existence."



1947 Howdy Doody joins other early TV broadcasts as Earth's first easily detectable signals into space.

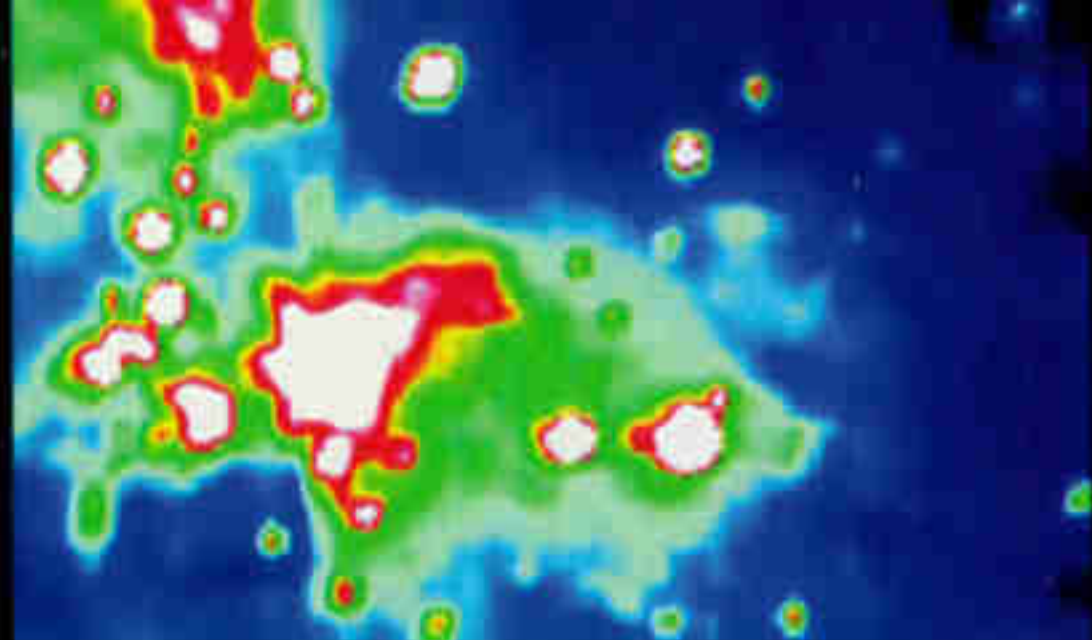
1996 ALH84001 creates a stir when NASA scientists say the meteorite contains evidence of ancient Martian microbes. Other scientists poke holes in the argument.



1999 Liquid water is found inside a 4.5-billion-year-old meteorite, giving us our first look at extraterrestrial H₂O.



1998 The Mars Global Surveyor reveals the face to be no more than a rocky mesa. True believers remain undeterred.



JEREMY BAILEY, ANGLO-AUSTRALIAN OBSERVATORY



NASA



Life and death in the universe

How does life begin? That's still a mystery, but we're finding clues. In a celestial cloud in the Orion nebula (top), polarized light could create an advantage for the kind of molecules that led to life on Earth. At NASA's Ames Research Center (right), scientists are learning how to recognize prebiological carbon molecules in interstellar space. The end of life can be more obvious. A gamma ray burst (above left), the most powerful phenomenon seen in the universe, could cause catastrophic extinctions on planets hundreds if not thousands of light-years away. Scientists see hundreds of these explosions a year.

showed them to be of a more advanced character than our own squabbling selves. H. G. Wells tweaked the idea just a bit in his novel *The War of the Worlds*, in which the Martians come to Earth with deadly heat rays and dreams of conquest.

The Martians, alas, were doomed, except as cultural artifacts. When astronomers looked at Mars with more powerful telescopes, there were no canals anywhere. Lowell's canals were created in his mind's eye—a classic example of the saying "Believing is seeing." But there remained, into the 1960s, a fascination with waves of seasonal darkening on the surface. Could this be vegetation? The Martian prairies and forests were conclusively eradicated in 1965, when the

Mariner 4 probe took 22 pictures of the surface. Mars was a cratered wasteland, reminiscent of the moon.

When the Viking landers descended to the Martian surface in 1976, they found no compelling sign of life and indeed discovered that the surface contains no trace of organic molecules. Though the mission was a fantastic triumph of science and technology, the absence of detectable life on Mars put exobiology into a two-decade funk.

The mood changed in the 1990s. Biologists were detecting organisms in such exotic environments on Earth that they were inspired to look anew at the rest of the solar system as potentially habitable. They also discovered signs that life appeared early in the Earth's

The science of extraterrestrial life has



history. Intriguingly, at about the time life arose on Earth, Mars was a much more hospitable planet than it is today. Images of the Martian surface indicate that the planet once had flowing rivers and perhaps an ocean. Life could even have started on Mars and spread to Earth aboard a meteorite.

Which brings up the most famous Martian meteorite: ALH84001. In 1996 a team of three NASA scientists based in Houston announced that this potato-size rock, found in Antarctica, contained what appeared to be Martian fossils.

The discovery was proclaimed at an unforgettable NASA press conference in Washington, D.C., on August 7, 1996. Everyone realized the historical glory of being right about these purported microfossils—and the reciprocal tarnish of being wrong. Dan Goldin, NASA Administrator, cautioned that the results were not definitive, but he said, “We may see the first evidence that life might have existed beyond the confines of this planet, the third rock from the sun.”

The NASA team made a dramatic presentation, complete with graphics and the first, startling images of the microfossils, one of which looked like a worm (others a bit like Cheetos). But then came a dissenter, UCLA’s J. William Schopf, who said that on a scale of one to ten of increasing probability of biological origin, he could only grant the alleged Martian fossils a two. So began, that day, an enduringly divisive scientific debate.

The NASA scientists had to admit that their four primary lines of evidence could each be explained nonbiologically. They had found, for example, PAHs, polycyclic aromatic hydrocarbons, which sometimes are associated with living things but which also can be found in car exhaust. They found grains of magnetite, which might have been produced inside microbes or might not have. In a sense the research raised the question of whether a series of possibilities add up to a probability. At the least it runs headlong into a Sagan dictum, which is that extraordinary claims require extraordinary evidence.

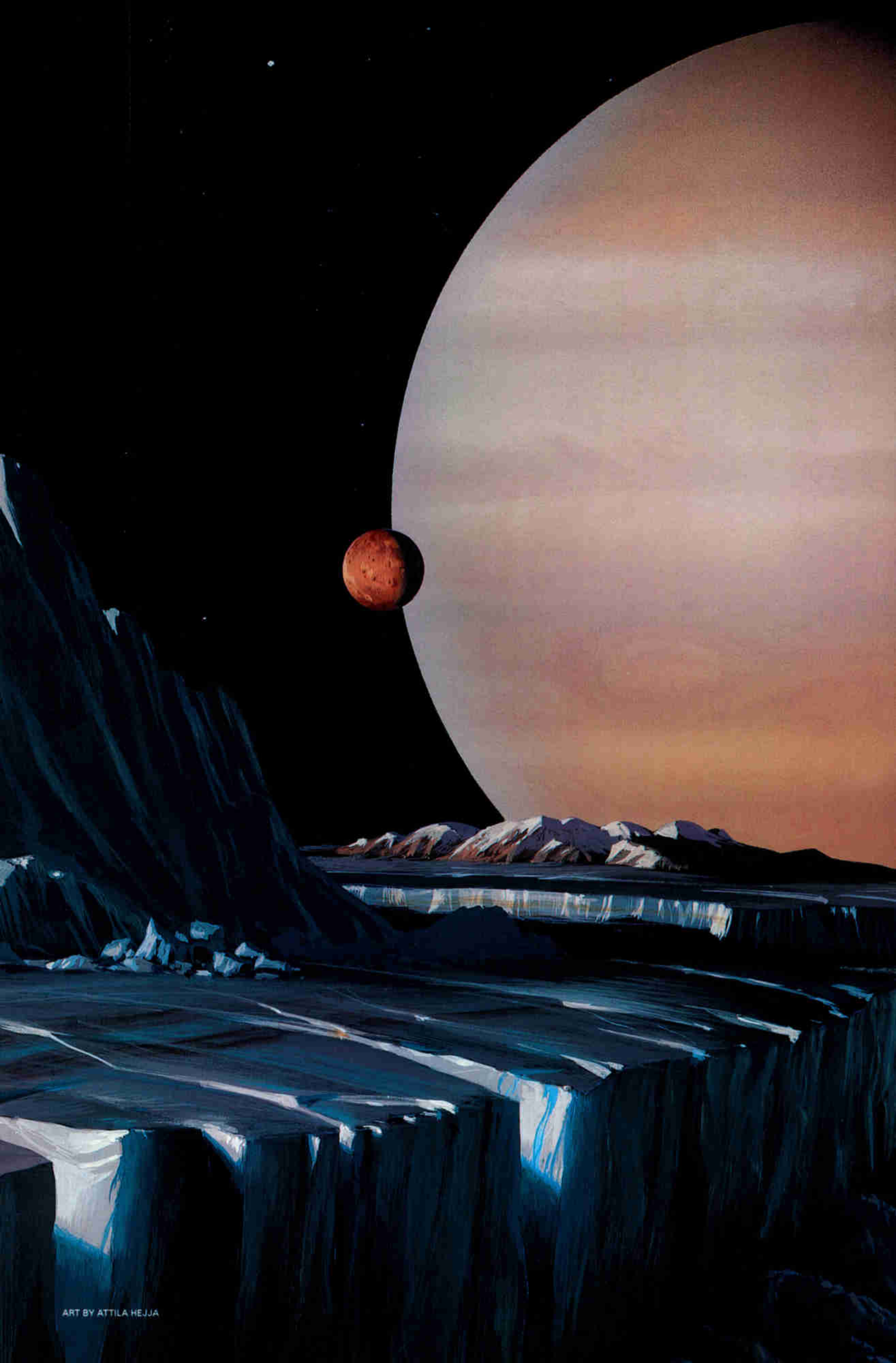
The NASA team saw its conclusions vigorously attacked. One damaging study showed that some of the microbe-like structures were merely flakes of the rock rendered more biological in appearance by the coating process used in the preparation of slides. Researchers also found contaminants from Earth inside the meteorite.

The team fought these challenges point by point, but after three years critics felt they’d pretty much killed off the Mars rock. Luann Becker, a geochemist at the University of Hawaii, told me, “I think we’re beating a dead horse.”

But Everett Gibson, part of the NASA meteorite team, sees this as a typical scientific resistance to a revolutionary idea. “Science,” he said, “doesn’t accept radical ideas quickly.”

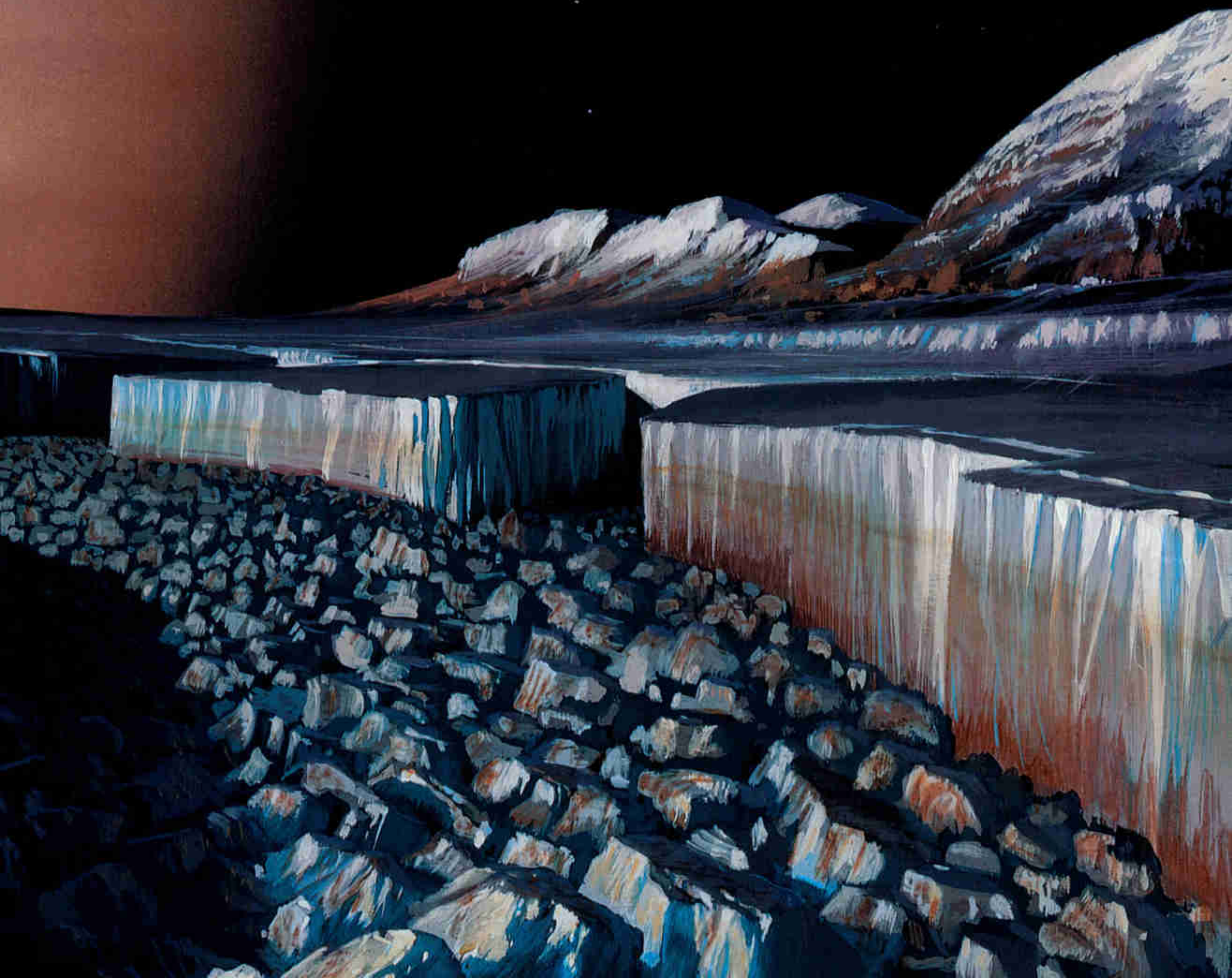
There was a time when scientists didn’t believe that meteorites could possibly fall from the sky. There was a time when plate tectonics—the movement and collision and subduction of vast slabs of the Earth’s crust—was deemed a very strange idea. Are the Mars rock fossils in the same category? Or are they more like those canals?

been infused with optimism in recent years.



LIFE IN A EUROPEAN OCEAN?

Jupiter dominates the view from Europa—one of its four large moons—and its gravitational pull may create enough heat to liquefy water under Europa's icy shell. If this pull also creates enough heat to spur volcanic activity, circulating chemicals that microbes could use for energy, the moon might harbor life.



WHY EUROPA MIGHT HOST LIFE



CRACKED ICY SHELL

NASA images reveal a European surface looking much like Earth's sea ice, rife with ridges and fractures. A lack of impact craters suggests that Europa is being resurfaced by geologic processes.



TIDAL HEATING

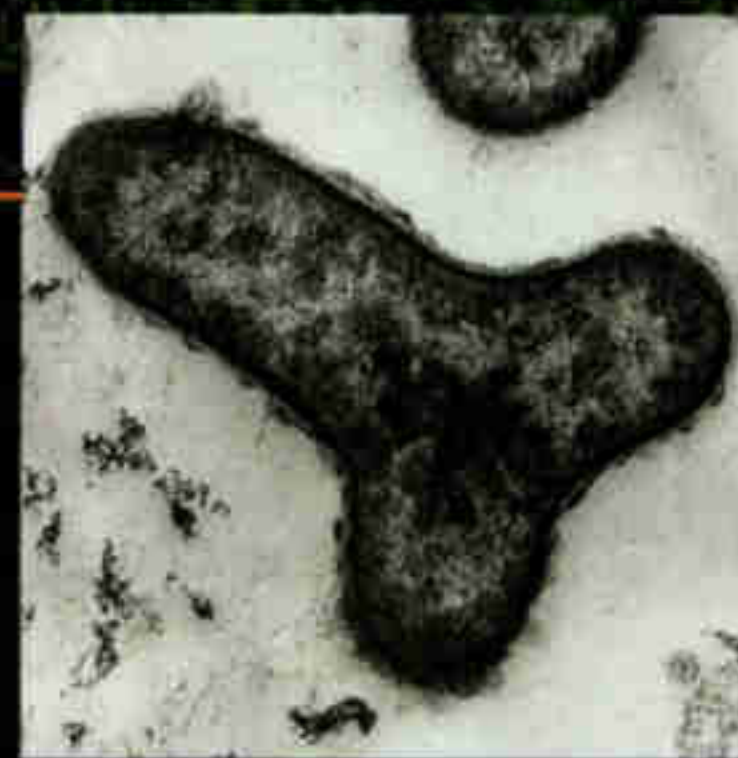
Jupiter's three innermost large moons are tangled in a gravitational tug-of-war with the planet and each other. Closest to Jupiter, Io is thought to have enormous tides in its crust; the intense friction has made it the solar system's most volcanically active body. Europa's tides are significantly less than those of Io's but could be strong enough to keep a massive ocean thawed.



WHAT'S INSIDE?

Below Europa's brittle crust of ice is a rocky mantle around a metallic core. What's interesting is what lies between the crust and the mantle: either a 60-mile-deep liquid ocean of water—ten times as deep as any ocean on Earth—or some sort of slushy ice compound.

Earth life may have started on the ocean floor, at hydrothermal vents like this "black smoker," glowing in infrared. Microbes at these vents can get all their energy from chemicals in the superheated water, though some, like the one here, have enough photosynthetic pigments to get 10 to 20 percent of their energy from light. "Maybe photosynthesis originally evolved around a vent like this," says microbiologist Tom Beatty. The microbes may prove to be descendants of surface organisms, but if not, they suggest that even a dark European ocean could give rise to life.



IF LIFE SPRANG UP through natural processes on the Earth, then the same thing could presumably happen on other worlds. And yet when we look at outer space, we do not see an environment teeming with life. We see planets and moons where no life as we know it could possibly survive. In fact we see all sorts of wildly different planets and moons—hot places, murky places, ice worlds, gas worlds—and it seems that there are far more ways to be a dead world than a live one.

Within our solar system the Earth may be in a fairly narrow habitable zone, not too hot and not too cold, just the right distance from the sun that water can splash around on the surface in a liquid state. And there may be many other things that make life on Earth possible. The tectonic activity recycles the planet's carbon. Mars has no such mechanism, and this seemingly minor deficiency may be the reason Mars lost most of its atmosphere.

The search for extraterrestrial life is in some ways a search for constraints, for the things that limit the emergence of life or the evolution of complex organisms. For calculating the number of technological, communicative civilizations, the most popular theoretical tool is the Drake equation.

In 1960 an American astronomer named Frank Drake became the first person to conduct a sensitive radio search for signals from extraterrestrial civilizations. He aimed an 85-foot radio telescope at two nearby stars and, after one false alarm, found no intentional signals. The next year, preparing for a meeting of visionary thinkers (including the young Sagan), he made an outline for how to discuss the probability of detecting intelligent life, starting with the rate of star formation and the typical number of planets and working through to the longevity of civilizations. "I thought it was just a gimmick. It's amazing to me now that it's in the astronomy textbooks," he told me.

Going through the factors from left to right— $N = R_* f_p n_e f_l f_i f_c L$ —you don't get very far before you hit some serious unknowns. Jill Tarter, who has dedicated her career to SETI, says, "The Drake equation is a wonderful way to organize our ignorance."

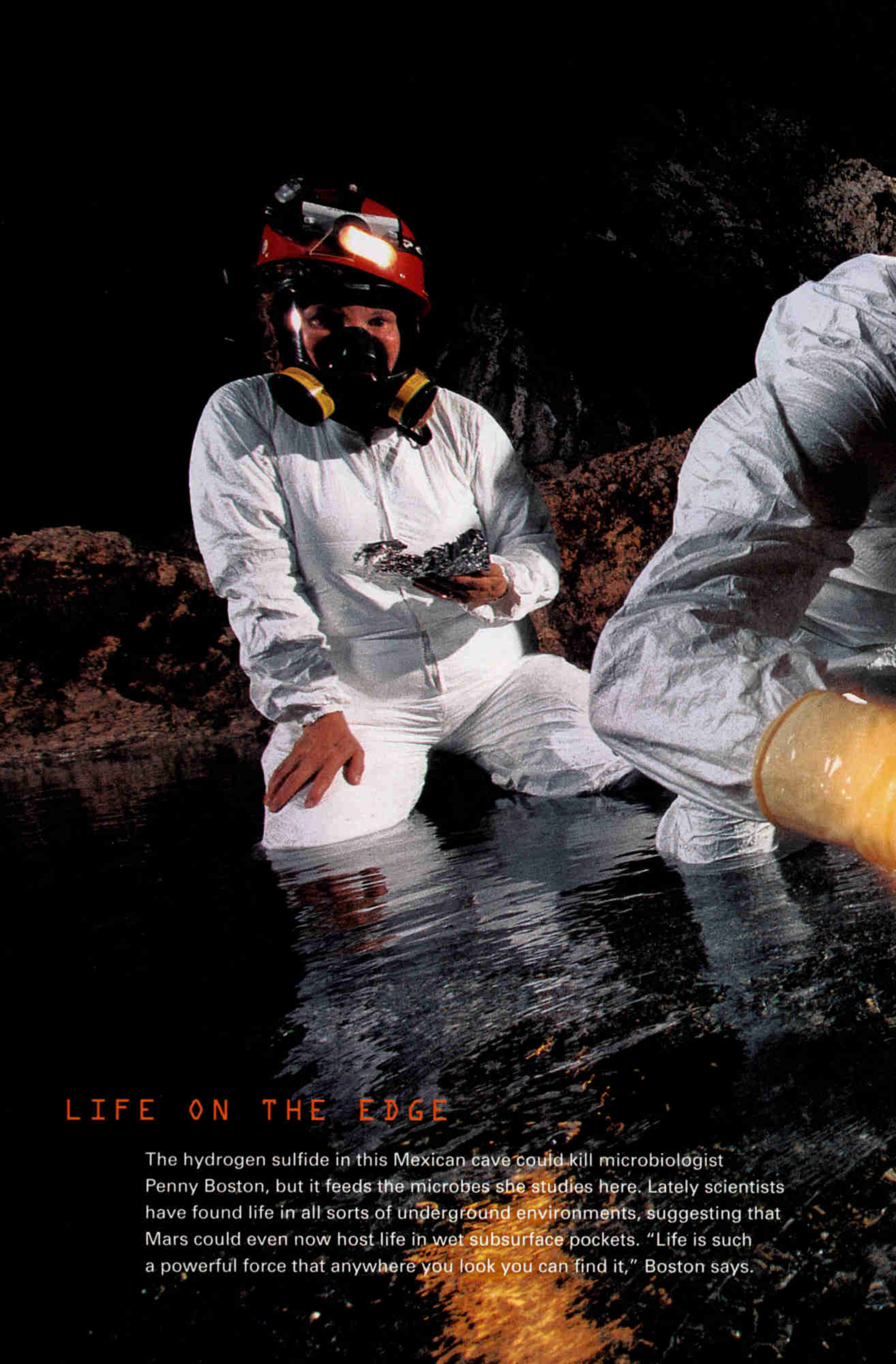
The only factor well understood, R_* , tells us the number of stars. Suffice it to say that there are lots of them, more than a hundred billion

in our galaxy alone, maybe as many as 400 billion (and that doesn't count, of course, the billions of other galaxies). The second factor, f_p , the fraction of stars with planets, is rapidly coming into focus. There are still uncertainties, since the detection equipment can find only extremely massive planets. These behemoths aren't like the Earth. Many of the extrasolar planets discovered so far may have migrated toward the parent star over time, destroying any rocky, Earth-like planets along the way.

Eventually the Terrestrial Planet Finder (TPF) could help solve the next factor in the equation, n_e —the number of planets with habitable environments—and may even be able to glean some evidence of the following factor, f_l —the fraction on which life has originated. TPF, still many years from construction, would capture the feeble reflected light from a distant rocky planet, while nulling the far more brilliant light of the parent star. This remnant of light might amount to only a single pixel of data. The light could then be examined for the spectral signatures of, for example, oxygen, methane, ozone, or some indicator of a planet with biological processes. Thrilling as such a discovery would be, it's easy to imagine how it would echo the situation with the Mars rock. There would likely be no "proof" of life, merely an interpretation subject to much second-guessing.

Even on Earth the origin of life is a stubbornly enduring mystery. "How can a collection of chemicals form themselves into a living thing without any interference from outside?" asks Paul Davies, a physicist and writer. "On the face of it, life is an exceedingly unlikely event," he argues. "There is no known principle of matter that says it has to organize itself into life. I'm very happy to believe in my head that we live in a biofriendly universe, because in my heart I find that very congenial. But we have not yet discovered the Life Principle."

No one is even sure that life requires liquid water, though that seems a reasonable bet and is surely the case on Earth. Liquid water may be fairly scarce in the universe—Europa may help solve that issue—but another presumed ingredient of life, organic molecules, those made up primarily of carbon, are commonplace. That's why Jeffrey Bada, a pretty hard-nosed researcher, thinks the universe is full of living things. "I don't see any way to avoid



LIFE ON THE EDGE

The hydrogen sulfide in this Mexican cave could kill microbiologist Penny Boston, but it feeds the microbes she studies here. Lately scientists have found life in all sorts of underground environments, suggesting that Mars could even now host life in wet subsurface pockets. "Life is such a powerful force that anywhere you look you can find it," Boston says.



that,” he said, sounding almost apologetic.

So let’s assume that life can spring up in many places. Now comes f_i , another giant unknown in the Drake equation: How often does life evolve to a condition of intelligence?

There are those, like Ernst Mayr, one of the great biologists of the 20th century, who argue that high intelligence has occurred only once on Earth, among something like a billion species. Hence it is a billion-to-one long shot. But Paul Horowitz, a Harvard physicist, argues that the same data can be looked at the opposite way: That on the only planet we know of that has life, intelligence appeared. That’s a one-for-one proposition.

I’ve never met anyone who thinks that if you rewind the tape of terrestrial evolution (to use Stephen Jay Gould’s metaphor) and played it again, you’d wind up with a genetically identical human being the second time around. But there are those who say that an intelligent being is more likely under certain initial conditions. The paleobiologist Andy Knoll argues that intelligence is rooted in the emergence of structures that allow simple animals to sense their environment and seek food. “If we get to creepy crawlies that look for food, then at some point intelligent life may emerge,” he says.

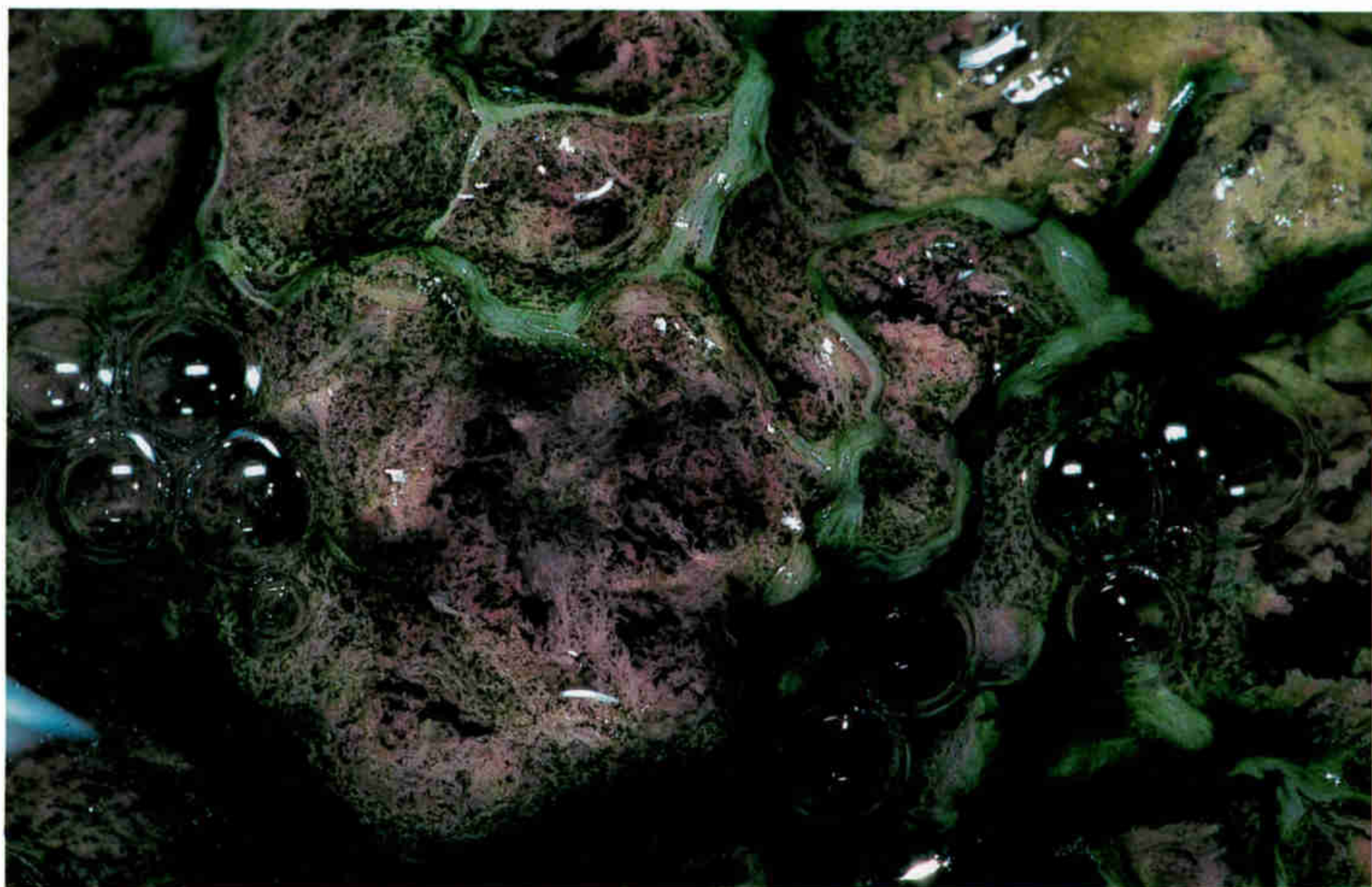
There are those who argue passionately that alien life would be nothing like us—in Fred Hoyle’s novel *The Black Cloud* the alien is a gaseous cloud that decides to feed on our sun—and there are others who say the biology of the Earth is probably a pretty good example of what’s out there.

Finding life somewhere else, even a single alien amoeba, might clarify the extent to which life evolves along parallel tracks—and whether it typically arrives at certain useful structures, such as eyeballs, wings, and large brains. Human beings have, by far, the biggest brains on Earth in ratio to body size. Did we get these things in our skulls through a random, improbable evolutionary quirk?

Lori Marino, a psychobiologist at Emory University, points out that dolphins appear to have undergone a dramatic increase in brain size in the past 35 million years, which may have a parallel in the quadrupling of brain size among hominids in the past few million years. By her reckoning, huge leaps in intelligence may be found among creatures on worlds everywhere else in the universe.

But it’s also true that the data are scarce, and this is still a territory for, among others, philosophers and theologians. What does it mean to

The lesson: There's so much we don't know —



be “intelligent”? When we “think” or “feel” or “love,” what is it that we are doing? When we ask if we are “alone,” we really want to know if there are others out there in the universe who are, in key aspects, very much like ourselves. We seek the communicators—Drake’s f_c , creatures who have the technology to send signals—storytellers, ideally.

EVERY THREE YEARS a bioastronomy meeting gathers many of the leading thinkers in the field. I went to the 1999 assemblage in August on the Big Island of Hawaii, and at the opening reception around a hotel pool a University of Toronto sociologist named Allen Tough offered a provocative theory:

“I think a probe is already here. It’s probably been here a long time.”

He didn’t mean flying saucers. His alien probes would be much smaller—“nano-probes,” tiny robotic exploratory craft sent to Earth from advanced civilizations. The alien probes may, at some point, let themselves be known to human civilization. How? Where? “I think it will happen on the World Wide Web,” said Tough.

Tough and about a dozen other visionaries

had a pre-conference meeting to discuss what to do if human civilization receives a “high-content” message from extraterrestrials. There was much uncertainty about how well prepared humankind is for such an event. We might have trouble crafting a response. Should we be forthcoming about the flaws of our species? If we acknowledge our history of wars and slavery, could that be misinterpreted as a threat? What if, even as an international committee of well-meaning thinkers tried to put together a message, some guerrilla radio broadcaster or “shock jock” beat everyone to it?

Bioastronomy also has its more down-to-Earth side. The meeting reminded me how much there is still to learn about our own little solar system. Exobiologist Jack Farmer made a simple yet stunning point one morning when he noted that neither the Viking landers in 1976 nor the Pathfinder spacecraft in 1997 carried to Mars the tool so vital to a geologist:

Maybe one day we’ll meet aliens who pour ketchup on their fries, but we’re more apt to find extraterrestrial life that eats carbon dioxide and hydrogen, like the methane-bubbling microbes that live beneath this mat of purple sulfur bacteria in a Mexican salt pond.

about Mars, about Earth, about life itself.





WHAT WILL IT LOOK LIKE?

As much as intelligent extra-terrestrial life could confound our expectations—the way this composite image is designed to do—physical and chemical properties are universal, so it is reasonable to expect that any intelligent life we're likely to encounter will share some basic characteristics with Earth life:

SIZE Intelligent life must be complex and multicellular, and scientists believe that cells have an inherent minimum size, so we don't expect intelligent life to be tiny.

HEAD Light, sound, and odor will exist throughout the universe, so sensory organs are good bets, probably located near a large, complex brain.

SKELETON An internal skeleton to support and protect vital body parts and a central nervous system for internal communication may be necessary.

LIMBS Intelligent beings will almost certainly have appendages for locomotion and toolmaking.

Although aliens could have multiple limbs and eyes, on Earth two eyes and four limbs work well without overtaxing the brain. That doesn't mean that we should expect to find Hollywood aliens though. "Nature is probably much more inventive than we are," says Seth Shostak of the SETI Institute in California.

a magnifying lens. Nor would the polar lander scheduled for a December 1999 landing carry such an instrument. Farmer's comment remained in my mind when Cindy Lee Van Dover, an oceanographer, noted that no one has ever made a dive in a deep-sea submersible to an active hot vent in the Indian Ocean to see what might be alive down there.

So before we worry about our dealings with the Galactic Empire, we have some serious fieldwork to do closer to home.

FREEMAN DYSON, a physicist, has argued that humans may engineer new forms of life that will be adapted to living in the vacuum of space or on the surface of frozen moons and comets and asteroids. In Dyson's universe, life is mobile, and planets are gravitational traps inhibiting free movement.

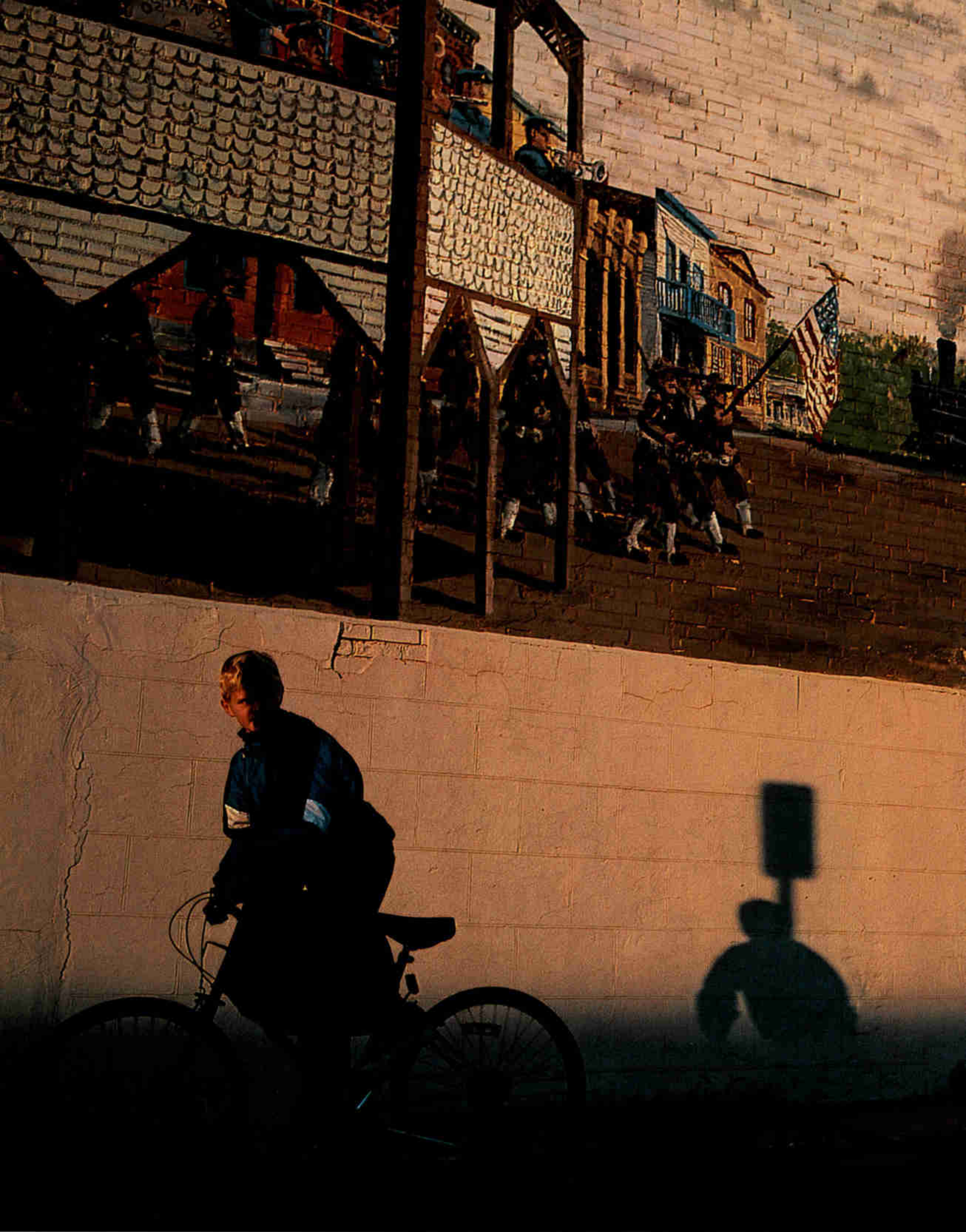
"Perhaps our destiny is to be the midwives, to help the living universe to be born," he said recently. "Once life escapes from this little planet, there'll be no stopping it."

But life must first survive this planet. The longevity of civilizations is the final factor in the Drake equation, the haunting letter L. Humans in their modern anatomy have been around only 125,000 years or so. It is not clear yet that a brain like ours is necessarily a long-term advantage. We make mistakes. We build bombs. We ravage our world, poison its water, foul its air. Our first order of business, as a species, is to make L as long an interval as possible.

I would hope that anyone who investigates this issue will come away with a renewed appreciation of what and who we are. In a universe of empty space and stellar furnaces and ice worlds, it is good to be alive. And we should remember that even if we find intelligent life beyond Earth, it may not be what we expect or even what we were searching for.

The alien may not speak to that part of our consciousness that we deem most important—our spirit, if you will. It may have little to teach us. The great moment of contact may simply remind us that what we most want is to find a better version of ourselves—a creature we will probably have to make, from our own raw elements, here on Earth. □

Does the evidence (or lack of it) for life beyond Earth justify our continuing search? Comment online at www.nationalgeographic.com/ngm/0001.



Crossing the continent, a British-born author and a Polish photographer chronicled their wanderings in words and pictures. From small towns like Ossian, Iowa (above), to America's biggest cities, the pair found a nation defined by its contrasts, comfortable with its contradictions.



Rediscovering America

BY TIM BROOKES PHOTOGRAPHS BY TOMASZ TOMASZEWSKI



"At sunrise the buildings of Manhattan look like pure gold," says photographer Tomaszewski. He



NEW YORK CITY

found a few thousand of those who helped build that golden city at rest across the East River.



Jim Curuchet and Antonio Rodriguez tend sheep under a big Wyoming sky. "Antonio is from



BUFFALO, WYOMING

Spain," says Tomaszewski, "but he fits in. Almost everyone in America is from somewhere else."



NEW YORK CITY

Did the America that had so captured

WHEN PEOPLE ask me why I left England to settle in America, I tell them a story about what happened in 1973 in Stroudsburg, Pennsylvania. I had landed in New York with my guitar, a sleeping bag, and the complete works of Shakespeare, which my college expected me to read over the summer. Like so many others at that time, I was going to cross America by thumb. I caught a bus to Stroudsburg, the first stop on I-80 in Pennsylvania, and got out on the verge of a strange, enormous continent.

Walking from Stroudsburg's bus-station-cum-general-store, looking for the interstate, I found myself among graceful wooden houses on maple-shaded streets, each lawn not walled or hedged in, in the English fashion, but flowing generously onto the neighbor's property and out to the ample sidewalk. On a corner

I saw a mailman kneeling beside a mailbox, emptying it. As I passed him, he looked up and called out, "Hiya, buddy!"

Coming from narrow, gloomy England, this incident stayed with me, as much a vision as a memory: an America of morning sunshine, the dew barely off the unfenced lawns, of an egalitarian cheerfulness and a future as full of unbounded possibilities as the continent itself. After returning to England for a time, I managed to land a teaching job at a college in Vermont, where I have lived off and on ever since.

Twenty-five years later, I was back on the road. NATIONAL GEOGRAPHIC had invited me to thumb across the U.S. again, traveling roughly in tandem with Tomasz Tomaszewski, a Polish photographer who had first ventured across the country 14 years ago.* I would write,

*See "Discovering America," by Malgorzata Niezabitowska, NATIONAL GEOGRAPHIC, January 1988.

"New York is proof that almost anyone and anything can coexist," says Tomaszewski, who found evidence on the set of a commercial in Manhattan (above). Two hundred miles and a century away, students visiting a Woodstock, Vermont, orchard catch suspended apples in their teeth and learn about the vanishing American family farm.

he would shoot, and periodically we'd meet and drive together, comparing notes.

For me it was a chance to find out whether the America that had so captured my heart and imagination still existed. Nowadays my adopted country seemed to have filled with dark shapes: religious cults with private armories, neo-Nazis, psychotics with shotguns in fast-food restaurants, satanists in the belfry, pipe bombs in the mail, poisoners and perverts, snipers in schoolyards, and chain saw killers up the dirt roads—monsters for every age and every political persuasion.

"Nobody will pick you up," one friend told me. "You'll be a target for every wacko from here to San Francisco," said another.

It took me less than a day on the road to discover the difference between imagined dangers and real ones. By nightfall I had reached Brookville, Pennsylvania, on I-80. At the bottom of a hill the interstate crossed a river over a long bridge. There was no shoulder, and the

trucks slamming past five feet away couldn't see me. The parapet was at knee height. The shallow river was a hundred feet down. As soon as each truck passed by, I ran as hard as I could until I heard the next one coming up behind me. Then I squeezed down against the parapet, feeling the whole bridge bounce as the 18-wheeler roared past.

Oddly enough, I wasn't afraid, just very focused. What frightened me was on the other side. Thirty yards beyond the bridge a truck had pulled over and sat idling, its hazards flashing. With its cab in darkness, it looked evil. I walked past it, like a kid passing a graveyard, when I heard a short hit on the horn. I turned round, took a deep breath, hauled myself and the pack up to the door handle, and opened it. The driver looked across at me.

"You'd better get in before you get yourself killed," he said dryly.

This would be a pattern for the trip: People would turn out to be friendly; my only enemy

my heart and imagination still exist?



At home in their rig, Lee and Keila Henderson tend to their daughters during a stop at Truck World. "My longest ride was with a trucker," says author-hitchhiker Brookes. "I developed a great respect for the profession and the hard, thankless work truckers do."

was myself. I wondered where I would have been that day without the young blue-collar guys in trucks or pickups who had given me five of my six rides. White middle-class liberals like me, the same people who in our youth had made hitchhiking a national pastime and symbol of the free spirit, had abandoned the faith.

I can't give my rescuer's real name, as truckers can get fired for picking up riders, so I'll call him Bob. He told me about the trucker's life, which all comes down to the loads you get, and what loads you get depend on whether the dispatcher likes you. "Dispatch doesn't like me," Bob scowled. "I complained about a few things. Now I only get bad loads. I got family in Texas, and once a month a load goes down there, but I never hear about it until after."

Bob's CB kept up an intermittent speckled chatter—truckers out in the darkness cracking jokes, warning each other about speed traps, passing on information about highway construction. In the dark, industrial world of his cab, rolling along the eerie midnight interstate lit only by vehicle lights and flanked by orange barrels, I felt out of place. The CB was the voice of an America that worked while most of the rest of America slept.

He dropped me off after midnight at Truck World in Hubbard, Ohio, which had a game room, an ATM, and a booth offering Internet access, as well as its own motel, surrounded on three sides by parked trucks. I staggered in, as grimy from 300 miles of hitchhiking as I've ever been. The guy running the motel was a chubby, elderly Asian. "Please tell me you've got a room," I gasped. "No," he said. My jaw fell. "Just kidding," he said.

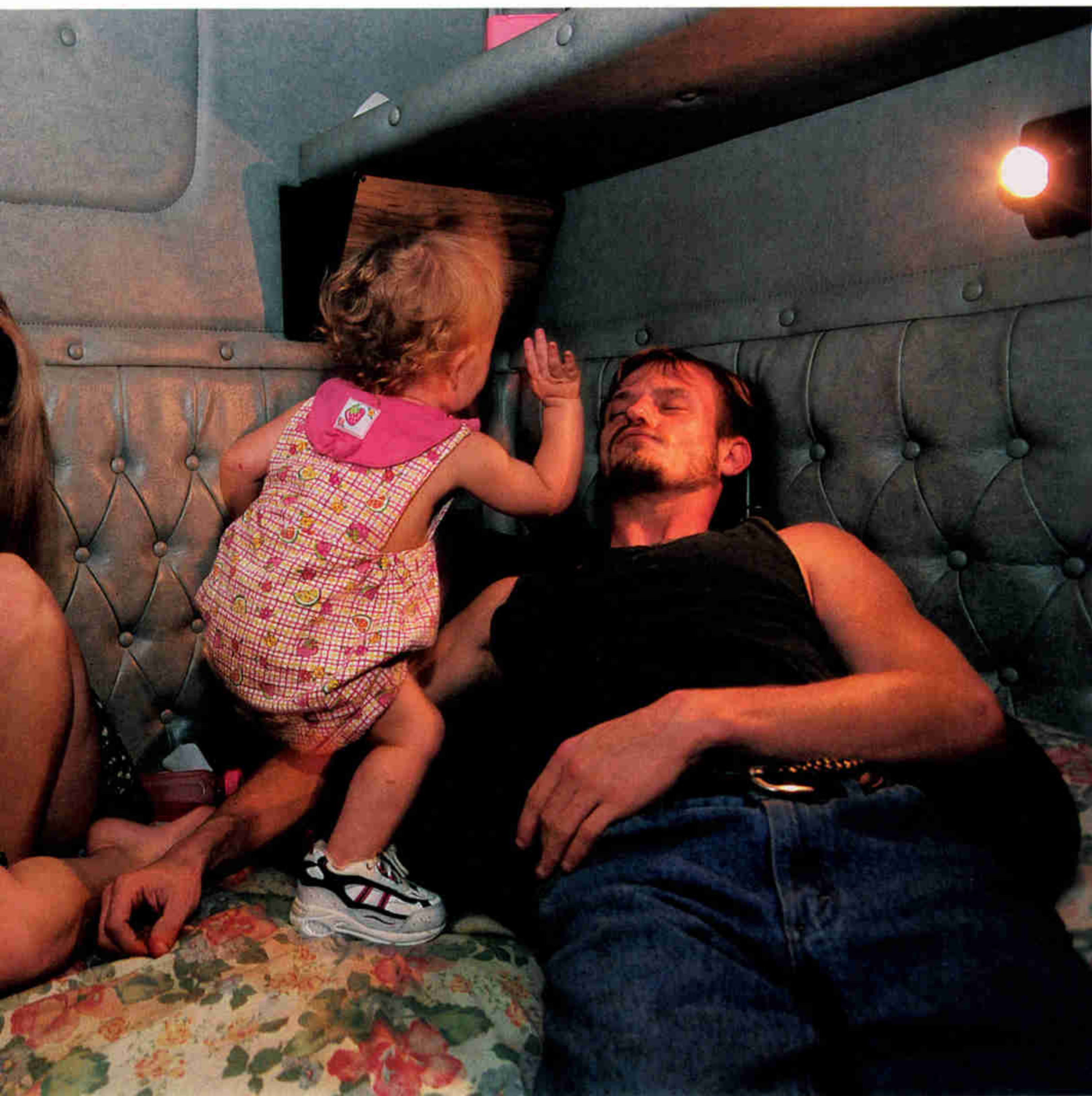
It was a decent room, in that the bed was horizontal. I fell asleep to the distant rumble of idling diesels.

TIM BROOKES's book, *"A Hell of a Place to Lose a Cow": My Road Trip Across America*, will be published this year by National Geographic Books. Photographer TOMASZ TOMASZEWSKI lives in Warsaw, Poland. He last photographed Blackpool, England, for the magazine.



Two mornings later I propped up my pack at the end of a service area on I-80 between Cleveland and Toledo. The secret of hitchhiking, like the secret of life, is to enjoy being where you are rather than dwelling on where you might be, but that wasn't easy with gasoline vapor wafting over me from the pumps and families in cars staring at me as if I were an illegal immigrant.

The morning became hot and sweaty under a colorless, glazed sky. It was over an hour before a courteous, elderly gent pulled over in a Lincoln Town Car, possibly the only Town Car in the world at that moment with three bricks



HUBBARD, OHIO

in the trunk. His name was George Persinger, and he was restoring Toledo's Rosary Cathedral. "Every brickyard," he explained, "makes a slightly different brick. I've got to take these to every yard in the area until I can match them."

George was one of a family of 17. "All we've ever done is mason work," he said. He's been doing restoration since he was 25, and it goes far beyond bricks and stone. In and around the cathedral, which was completed in 1940, he's putting up netting to keep pigeons off the statues, replacing rotten wood sheeting under the tile roof, replacing wiring and insulation. In one place he found that the heating ducts

had never been hooked up, so for years the vapor in them had simply been piped into an attic, where the condensation had rotted all the sheeting. "I spent 24 days in that attic," he said.

George parked beside the cathedral, a Romanesque building reckoned to be one of the finest cathedrals in the country, and I met his sons, Tim and Chris. George opened the main door and threw on some lights. The interior was magnificent—one flight of inlaid steps alone was made of hundreds of pieces of marble in half a dozen different colors—but the scale of the restoration was readily apparent. The cracked marble above the heating

registers had to be replaced. The walls and windows, especially above the votive candles, were black with soot. Such work transforms the emotional tenor of worship. The stained-glass windows before cleaning were solemn; those that had already been cleaned were joyful. I had a sense of a faith built soul by soul, a cathedral built and cared for stone by stone.

MAJOR CITIES are a headache to hitchhike into, so I got on a bus to Chicago. The driver was a short, sharply dressed young black man named James E. Carter. As he pulled us onto the highway, he ran through his own version of Greyhound's house rules in a cool, amused tone.

"There will be no smokin' or drinkin' on the bus, and no snortin', injectin', or hallucinatin'. If you smoke or drink, I'll pull over at the next service area and put you out. If you're snortin', injectin', or hallucinatin', I'll pull over at the next service area, and *I'll* get out." He paused for effect. "Just messin' with you. My name is James. I'm not the driver for this trip. Your driver for this trip is Our Heavenly Father."

Soon the greasy sky of Ohio was gone, and we were in Hoosier farmland, where the corn was as high as an elephant's knee. A hawk circled over a swamp. The middle-aged woman across the aisle told me in a Tennessee twang that she and her nephew (or perhaps her grandson, I wasn't sure), sitting in the seat behind me, were on their way home to Elkhart, Indiana, from Vermont.

That's where I live, I said. Did you see the mountains? The lakes? No, she said, they saw the Rock of Ages granite quarry, and they went to the mall.

The boy, who was going into sixth grade, had done a project on Vermont. She had taken a week off work for this epic trip together, traveling a thousand miles each way, sleeping on the bus, just so he could spend two days in the Green Mountain State. But once they'd arrived, they were stuck, unable to visit all the sights she'd looked up on the Internet. In America, not having a car condemned them to wander the mall, the pedestrian's last refuge.

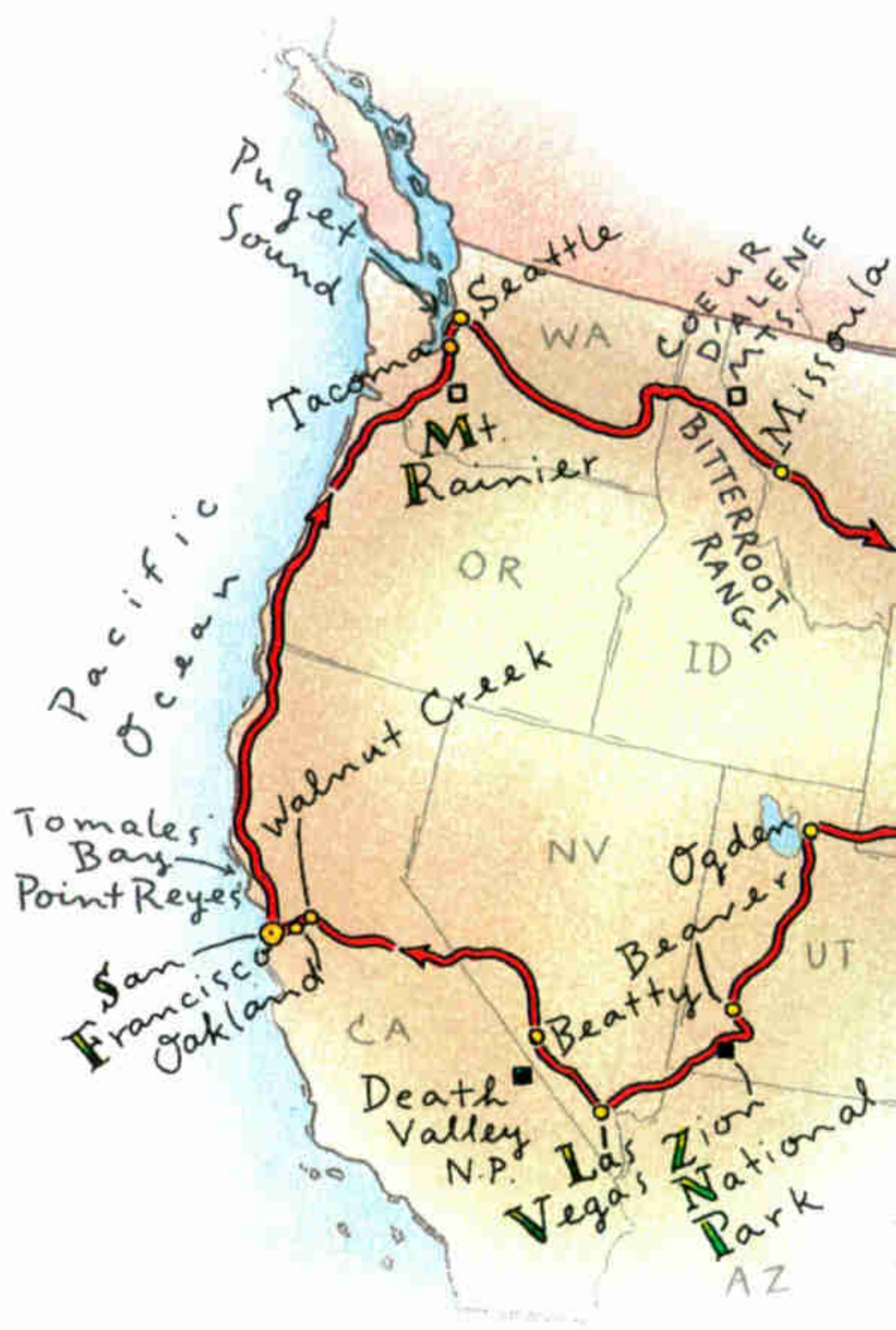
As we pulled off the interstate into Chicago, James was on the mike again. "Greyhound hires only professional and handsome drivers. Ladies, if over the last few hours you've fallen

in love, become infatuated, or been seized by passion, please, please, *please* control yourselves when leaving the bus." He offered thanks to the Light of the World for a safe trip.

The combination of a heavy pack and the hard streets of Chicago aggravated an old knee injury: I could barely walk, let alone hitchhike. Next morning I limped to the Greyhound station and bought a ticket for Iowa City, then phoned Tomasz to set up a rendezvous. He was in Peoria, Illinois, and had just photographed a building covered in hubcaps. "It is quite fantastic, I think," he said.

On the bus, I read the journals of Lewis and Clark and listed the Top Ten Things Lewis and Clark Encountered in the First Month of Their Expedition That So Far I Haven't: bears, wolves, Frenchmen, buffalo dung, quicksand, three "verry" large snakes, 300 pounds of grease, ticks, boils, "deassentary." But my pack needed lightening, and when Tomasz pulled over to the curb where I was sitting in Iowa City, Lewis and Clark went into the trunk of his rented Buick.

We drove through the undulating pastures of Iowa in the golden late afternoon and by the



In 30 years as church members, Deacon Eldridge Falconer and his wife, Amanda, have seen Second Canaan Missionary Baptist outgrow two buildings in Detroit. "The church holds these families together," says Tomaszewski, "and families bind the community."

end of the day had reached the small town of Indianola. I picked up a local paper and, over chicken pot pie, read the calm, bucolic news of the region: White bass could still be caught below the dam at Saylorville, and though the catching of crappie had slowed down because of high water from the recent rains, there were still a few to be found along roadbeds and parking lots covered by the floodwaters.

Early the next morning we pulled up at the Warren County Fairgrounds on the outskirts of Indianola, while the sun was still slanting low over the trees. This is my favorite time for a fair—the farmers and their wives and kids setting up, coaxing the sheep and goats into the stalls, three handsome Swiss cows staring toward the back of the grandstand, the wood shavings in the horses' stalls still clean and smelling sweetly of cedar. The carousels and miniature trains were silent, the fast-food carts locked up. Only the flags stirred, and the fringe on the red-yellow-and-blue canopy over the toy motorbike ride. A great dignified cottonwood leaned over the video-arcade tent.

"Pretty quiet this morning," said a farmer in blue jeans, blue cotton shirt, and a blue baseball cap. "Couldn't get much better, could it?"

But the bright promise of the day clouded over as we drifted west, and in the sad, stagnant towns of Griswold, Iowa, and Rising City and Shelby, Nebraska, under steady drizzle, the whole country seemed bleak and shattered. I was beginning to realize that America would always be what I made of it: Exhausted and bored after a day of rebreathing the same stale air, I stared out of the window and saw in America my own reflection.

Next morning I was up at six. Tomasz was going to shoot a replica of Stonehenge made of junk cars. I was relieved to be on my own again, on the weedy grass by the interstate, rain running off my jacket and down my bare legs. After 20 minutes a truck pulled over. The trucker's name, let's say, was Chris. Through the gray, damp heart of Nebraska we talked

about trucking and the weather. He said he once came along I-80 soon after a tornado and found pieces of a barn on the road and pigs rooting around on the median. Another trucker he knew, driving late at night way up near Grand Forks during the 1997 Red River floods, came across a three-story house in the middle of the road. In winter Chris often has to use chains. His rig needs eight sets, four on the cab drives, four on the trailer, and putting them on is a pain. "It can take three hours under your trailer, with snow dripping down your neck."

Like me, he believed that Americans had lost sight of the small, important things in life.





DETROIT, MICHIGAN

"I think a lot of people have lost hope that tomorrow will be better, that the weekend will be nice. My grandfather's idea of a good day was waking up, having a cup of coffee, scratching his dog behind the ears, and being able to go out and see horses. And that's not bad. We get oversold on larger-than-life." Chris liked gardening and pottery. He wished he knew the constellations so he'd have something to look for in the night sky.

As we approached the Wyoming border, everything changed. The endless corn gave way to fields of half a dozen different colors: dun-colored bare earth, spring-green shoots, golden

stubble. Then we were on the High Plains, all bare hills and undulating grassland. The rain stopped at the same time, the sky cleared, and the shadows of small clouds rose and fell across the rippled plain. We saw our first artesian wells, our first nodding donkeys. Power lines stapled the horizon, coal and ore trains trundled alongside us, and cattle clustered around wells and feed bins.

There were gates at the entrances to the interstate, so they could be closed for snow, then cattle grids appeared by the gates. Bluffs appeared on both sides of the valley, then pines on the bluffs. Wonderful rock formations like



Flanked by the sacred and the profane, a homecoming parade for Dakota Wesleyan University



MITCHELL, SOUTH DAKOTA

marches past Wild West facades and an outdoor statuary shop on Main Street.

October's chill descends, and Eric Conrad, at left, pauses with his pals in downtown Mitchell. Gone are most of the 500,000 tourists who come annually to see murals made of ears of corn on the nearby Corn Palace. Now locals brace for winter's frigid familiarity.

piles of chocolate chips grew above the small rivers. The West was starting to look western, and even to adopt a certain cultural self-consciousness, as if aware of its obligations. We saw our first Stetsons. Truck stops rented audiotapes of Westerns: *Lady of No Man's Land*, *Treachery at Triple Fork*.

Chris pulled over for the night at the Flying J Travel Plaza in Rawlins, Wyoming. He slept in the cab; I hung out in the truck stop. At the next table four truckers were telling lurid yarns of drivers murdered by hitchhikers. I strolled over and said, "I'm one of those killer hitchhikers you've heard about." They laughed, we swapped stories, and they told me that I should stop in at the Harley-Davidson rally held every August in Sturgis, South Dakota. "That'll show you the real America," they said.

Then they left, and I was back in my adolescence, staying up all night in a truck stop waiting for a driver to wake up or just waiting for dawn, eyes stinging, nose itching from cigarette smoke, putting my head on my arms on a Formica table. The big-screen TV in the drivers' lounge was out because the dish had been hit by lightning, so the steady background sounds were country music on the PA system, the grunts and thuds of kung-fu games from the video parlor, and the prerecorded announcements from the ablutions hostess: "Shower number 237 is now ready."

THE AMERICA I KNOW is the green hills of northern New England; it was hard to believe that western Wyoming was on the same planet. Gray-green ranges lounged on the horizon like iguanas, mesas like elephants' feet hemmed in the dry valleys. The landscape was completely barren except for chemical plants and soda mines, and utterly without shade as far as the eye could see. Once Chris and I reached the horizon there was another barren and bizarre landscape as far as the eye could see, then another, then another. Nothing can prepare the

outsider for the scale of the West or the shock that people actually live there.

Chris dropped me in Ogden, Utah, where I discovered Farr's homemade ice cream, a new extreme in eclectic flavors: Raptor Ripple (named after the local baseball team, the Ogden Raptors), licorice, play dough.

From Ogden I took a bus to Beaver, Utah, to meet Tomasz. I'd been waiting for 20 minutes outside the El Bambi diner, which doubled as the Beaver bus station, when he pulled up in the Buick looking dazed. "I must tell you, this is something completely new for me," he said. "I drive 18 hours to see someone who is neither





MITCHELL, SOUTH DAKOTA

my girlfriend nor my wife nor my child. This has never happened to me in my life.”

Two days later, making for a friend’s house in Oakland, California, I set up in the tiny old gold-mining town of Beatty on the side road that led to Death Valley National Park. My plan was to be able to say, “I hitched through Death Valley,” but almost no traffic was going that way—just the occasional sport vehicle packed to the roof with tents and mountain bikes. I crossed over to the main road to Reno and after another 90 minutes of thumbing in 95-degree heat was picked up by Hank Doucet, a 50-year-old artist from New Mexico who

was going nearly all the way to Oakland. “New Mexico, eh?” I said, thinking of tales I’d heard of strange sights in the southwestern deserts. “Ever seen a UFO?”

He raised an eyebrow. “Curiously enough, yes. Two weeks ago. The mayor of the town I live in and I were driving back from Albuquerque at 10:30 at night, and a string of white lights was following us across the desert. It would surge up on us really fast—I was going about a hundred miles an hour—and this thing would go *whoom!* It was a diagonal row of white lights; that’s all you could see. It would zoom back. And then it would zoom away.”



Under a 90° sun Godfrey Chipps is happy to be hosed down by his brother Trevor on the Pine



WANBLEE, SOUTH DAKOTA

Ridge Indian Reservation, where their father will lead a Lakota Sioux sweat lodge ritual.



CASPER, WYOMING

The West was starting to look western

Hank paused. “There was no way of getting any perspective because it was dark. But this thing was gaining on us and moving away, gaining on us and moving away. Finally I said, ‘The hell with this, I’m going to stop.’ And as soon as I took my foot off the accelerator, it went *whoom!* back and shot out of sight, gone. Then we stopped the car—we were right at the back entrance to White Sands Missile Range, and within two minutes they scrambled I don’t know how many jet planes and helicopters, one after the other. They scrambled the entire base in the direction we saw this thing go zooming off in. It was unbelievable.”

Hank dropped me off in Walnut Creek, a wealthy suburb in the Bay Area, half throttled by freeways. The Pacific was now almost within sight, but it seemed that my only hope of reaching the West Coast from Walnut Creek without having to walk was to rent a car. In

1973 people hitched around the Bay Area as a form of commuting, but the only person I passed at the freeway entrance was a ragged man with a sign, “Purple Heart No Income Small Change Anything Will Do Please Help.”

I was so caught up in the tangle of highways and signs that it was a few moments before I realized that the patch of brilliant silver sunlight on the horizon was the Pacific. It had taken me 11 days to cross America.

In Oakland I took stock. Hitchhiking seemed to be agreeing with me. I was sleeping much better than usual. My asthma had vanished. I was drinking more juice, eating less comfort food, and digesting better. I had discovered that, like many of us in America, I normally eat twice as much as I need. Above all I felt lighter of spirit, more curious and less afraid, as if by plunging into America I had plunged into life itself.

Trophies pile up at Pearce Butchering in Casper, where, says Tomaszewski, “everyone I spoke to presented himself as a sportsman.” Friendly bars like the Century Club (facing page) impressed Brookes. “In England you go into the wrong pub and you’re stared at. Every bar here—western, urban, biker—I was amazed at the affable reception.”

“CHECK. One two two two. Check. One two.” Glide Memorial United Methodist Church in San Francisco was packed and stiflingly hot. An usher in a road-crew reflector vest handed me a purple fan and directed me to the far side of the room. “There’s room for two on that windowsill,” he said.

“Check. Check.” The band—guitar, bass, synthesizer, percussion—tuned up. The choir came in, swaying and clapping in their purple and gold robes, all colors, all races, all ages, everyone cheerful and rocking to the music. Within minutes the usher warned me not to jump up and down on the windowsill because the heating register in the sill might collapse.

The Reverend Cecil Williams, beaming, rotund, bespectacled, bearded, his hair thinning, called out, “Yeah! Oh, yeah! We *looove* it when it’s hot!” Everyone laughed. On stage next to him was an interpreter for the deaf, who drew out his signs as Cecil drew out a word, bending

them like a harmonica player bending a note. He moved with the music like Joe Cocker.

“You’re at the right place,” Cecil said. “You’re at the right place to be loved.”

More wonderful singing, a rousing trumpet solo, then Cecil’s sermon on spiritual openness, using the metaphor of a jar. He had fun riffing on the word jar (jarring experiences, remaining ajar). “How’m I doin’?” he called out, and we all cheered. This was the first church service I’d ever been to that was worth it for the beautiful women or the dancing by the handsome young black man on stage at the end. It was wild, it was passionate, it was full of human warmth and compassion, and it was the first place where I had heard people en masse expressing hope for the country’s future.

The following morning, clouds from the open sea streamed through and under the Golden Gate Bridge and died in streamers in San Francisco Bay. The fog rose and fell in a slow, cold boil. Sometimes I could see the cars

. . . as if aware of its obligations.



BUFFALO, WYOMING

"I think of the U.S. not just as a country but as a continent," says Tomaszewski. "It has a variety of landscapes that don't exist anywhere else." To Brookes, the rock at Zion National Park (right) "seemed almost fluid, rippling and eddying around you."

on the bridge, sometimes just their lights, sometimes just the supports themselves, floating on a pillow of white cloud. Invisible freighters moaned like whales.

Already the city was vanishing back into memory. I could be sure only of the here and now, the tawny hillsides of the Marin headlands in bright sunlight, the boy finding a lizard among the rocks, and the hawk circling above the bay, wing tips raised like fingers.

Just north of Point Reyes a woman of about my age and a spry, older man appeared from a little driveway near me, she carrying a bottle of water and he a bottle of Anchor Steam Ale. "We thought you might be thirsty," the woman said. "Would you like water or beer?" I went for the water. "By the way," she went on, "My name's Jan, and this is Ramblin' Jack Elliott."

Yeah, I thought, and I'm Frank Sinatra. But he *was* Ramblin' Jack Elliott, the singer who learned from Woody Guthrie, taught Bob Dylan, and brought American folk music to Britain. He inspired countless young would-be musicians to pick up a guitar—including, indirectly, me. We sat at a picnic table under a tree outside Jack and Jan's little house, as ordinary a place as you'll ever find a saddle, lariat, and boots tucked away in a corner and a Grammy next to the TV.

He told me about falling in love with the sea after reading NATIONAL GEOGRAPHIC, how he ran away from his Brooklyn home ("no place for a cowboy") at 15 and joined the rodeo for two dollars a day, sleeping three feet away from the horses' tails and learning guitar from the rodeo clown. He told stories over beers, he told stories while we played guitar, and then he told stories out on Tomales Bay when neighbors came over and invited us for a sail on the trimaran they had built themselves. As the sun went down, the water was suddenly full of hundreds of medusas, pulsing alongside like small aquatic ghosts. And all the while the three-quarter silver moon rose higher and higher above the bay.



NEXT MORNING I flagged down a ride 800 miles to Tacoma, Washington, with James "Jay" Hays. As we tooled up the coastal highway, the Pacific Ocean was invisible behind a fogbank that hugged the foot of the cliffs. Still, it was one of the most beautiful roads I'd traveled, skimming the line of the cliffs and then darting inland through groves of pine or eucalyptus, rising and falling as it crossed the innumerable streams, surprising a small coastal town and then dodging back into the woods again.

Jay drove us up through the redwood forests to a house overlooking Puget Sound. His



ZION NATIONAL PARK, UTAH

roommate, Emiel Kandi, who described himself as a finagler and a wheeler-dealer in real estate, offered me a ride the next morning into Seattle. Around 8:30 a.m. Emiel drifted downstairs for breakfast—coffee and two Pepperidge Farm cookies—and disappeared upstairs to shower, reappearing in a dark blue Italian suit, black shirt, and sunglasses. He opened the trunk of his brand new Cadillac Eldorado, tinted windows and all, and laid my pack on a pump-action shotgun and a sword in a studded leather scabbard.

We pulled onto the road, and at once he was on the phone, setting up a meeting. At 21,

Emiel already owned several duplexes and the house in Tacoma, and now he was trying to raise two million dollars to open a casino.

He took me down to the site of the casino-to-be. “Most people’s problem is they don’t know how to handle money,” he said. “They’re afraid of it. I hooked up with a bunch of Italians at a very young age, and they taught me how to live well.” He grinned. “I tell people I’m Arabic by birth but Italian by choice.” He gave me his e-mail alias: godfather.

At Pike Place Market in Seattle, Emiel hauled my pack out of the trunk, evaded an invitation to explain the shotgun and the sword, and

shook my hand with genuine warmth. Six weeks later I e-mailed him, half expecting the address to be a joke, but he replied, saying he had raised his money. Construction would begin in nine months.

I had hoped to cross into Canada from Seattle, as I did in 1973, but Tomasz called to tell me that the bikers' rally at Sturgis, South Dakota, would be over sooner than we had thought. I had two and a half days to cross a third of the continent and meet him there.

In Idaho a well-ridden pickup pulled over, its bed full of storm windows, bicycles, and steamer trunks. The driver, Kevin Wallen, was a wild-looking guy in cutoff sweatpants, his blond hair combed back from a receding hairline to fall down over his shoulders, his chest and thighs tattooed, a front tooth missing. He had a curious sidelong look, a cross between a grin and a glower, and spoke in a high-speed mumble, in clusters of words that shot out of the corner of his mouth.

"Seat belts don't work," he muttered. "I kinda throw one over my shoulder." He demonstrated, looping the useless belt over his left shoulder and letting it fall down at his side. "Gives the cops something to see."

"I make horsehair bridles," he said. "Just sold one to a museum. Two thousand bucks." He said he'd sold half a dozen, and he'd started making them only a few months before.

"Where'd you learn that trade?" I asked.

"In jail." By now the highway was running alongside wild streams and rocky rivers, up between the pine-covered Coeur d'Alene Mountains on the left and the Bitterroots on the right. This was a genuine mountain pass: on one side mountain, on the other side nothing. He settled himself in his seat with an expression of grim glee and set the cruise control on 84 mph. "I used to be a cocaine addict," he mumbled. "Now I'm an adrenaline junkie."

The gorge rolled up beneath my window as we entered the curve, the guardrail looking as flimsy as tin ribbon. At that speed the truck felt high and loose, the tires almost liquid. The g force plastered me against the door—which, it occurred to me at this very second,

"It was 6:30 a.m., and this coffee shop was safe and welcoming—even to me, a foreigner," says Tomaszewski. And as the sun rose that day into the endless, stark blue western sky, recalls Brookes, "It seemed as if anything was possible."

was probably in as bad shape as the seat belts and might fly open at any pressure. An insane calm fell over me. At this speed, it didn't matter whether the seat belts worked or not. Let it go, I thought. *Let it go.*

"My God!" I breathed, as we straightened out. "Yeah," he said happily. "My heart's still poundin'!"

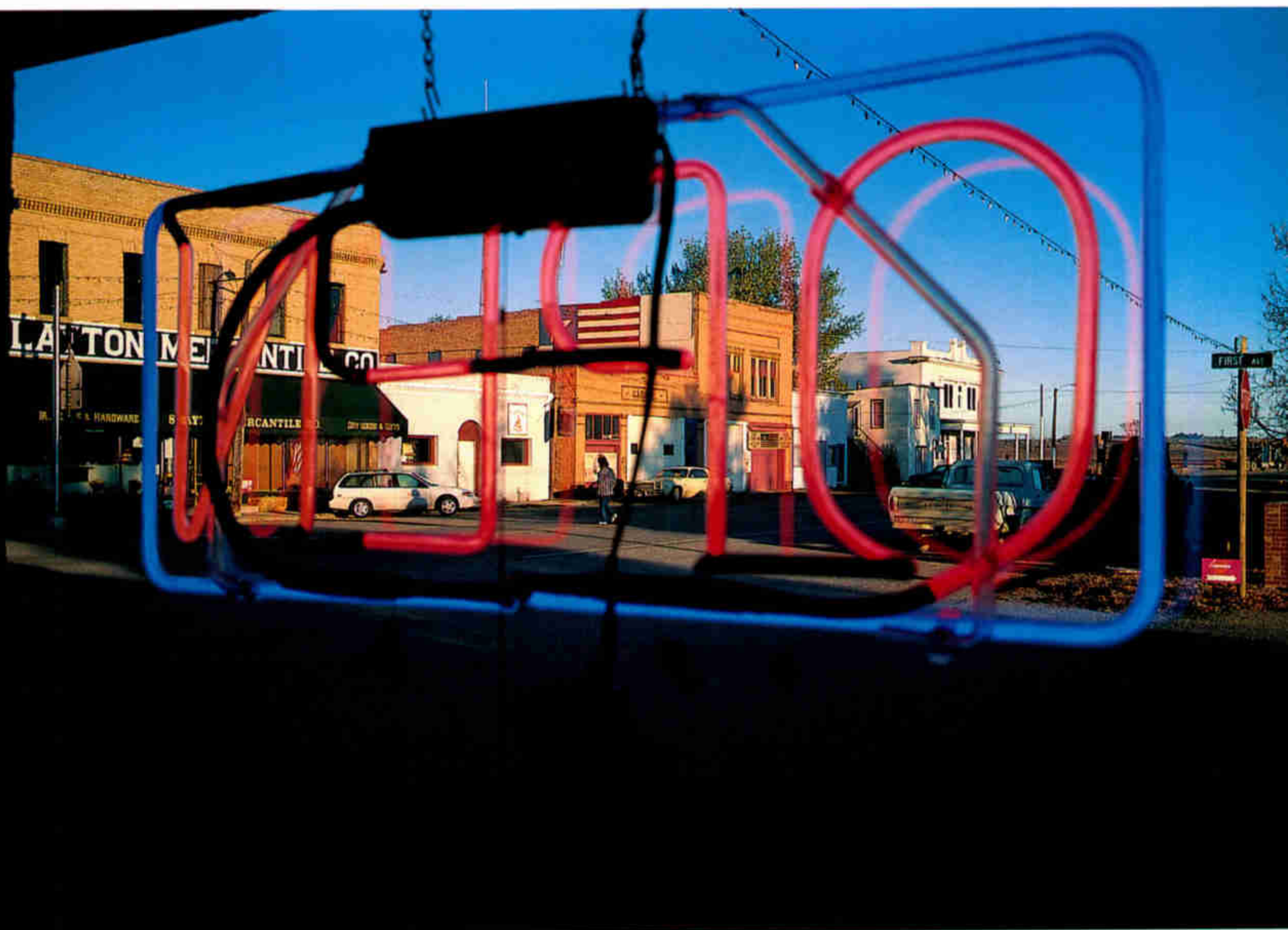
He just had time to tell me about his brother being shot—not fatally—and then we were pulling off the interstate in Missoula. Struck by a thought, he rummaged around in the truck bed, hauled out a trunk, and produced one of his bridles. It was tightly and expertly woven in what to my untutored eye looked like a series of Navajo designs, with tassels on each end. He gave me his card—well, someone else's card, with his name scrawled on the back—so that, he said, when I saw his work hanging in some

I was beginning to realize that America

gallery in London next to a Picasso, I could check the name and know that it was his.

THE APPROACH ROADS to Sturgis were thick with Harleys roaring out of town singly or in swarms, like heavy metal hornets. Hundreds of pole-and-awning stores selling tattoos and biker gear were being dismantled; Indian taco stands were turning back into plumbing supply stores. The Road Kill Cafe was closed. Like some aging comic book superhero, Sturgis was tugging off its leather costume, turning back into a mild-mannered small South Dakota town. A cop was going into the Meade County Law Enforcement Center with an armload of stuff, cleaning up. How many bikers had come this year? "Three hundred and fifty-seven thousand, two hundred and twelve. There were two hundred and thirteen, but one left."

I'd set out feeling half afraid of bikers, yet



LAVINA, MONTANA

would always be what I made of it. . . .

Sturgis, though raunchy, was cheerful and harmless. For a week it had had the population of a city the size of Minneapolis, yet apart from DUI and drug arrests it had been virtually crime-free.

I met up with Tomasz, who over the past two days had photographed the inventor of the Body Web (the least amount of clothing one can wear in public without getting arrested), the mayor of Sturgis marrying couples on their Harleys, and the World's Most Tattooed Man. Tomasz ducked into a leather shop that was on the point of closing. Its resident model wore black leather chaps, a black leather bustier, and a sort of black leather fig leaf fore and aft, leaving most of her back and both buttocks naked. She posed for him, flashing a huge smile that involved several ounces of fire engine lipstick. Her name, she said, was Dawna.

"I am thinking she is cool," Tomasz said, looking after her and nodding thoughtfully.

Next day Tomasz and I drove through the Badlands. A fringe of canyons carved in a thick layer of mud and ash left by a long-extinct volcano, they seemed to have been made out of wet cement and emitted a blinding gray glare.

This was the northern border of the Pine Ridge Indian Reservation. More than a century ago the Lakota Sioux were driven into South Dakota, and when gold was discovered under Indian soil, they were penned into ever smaller and more barren scraps of land. Pine Ridge is now one of the poorest and most isolated communities in the U.S. Unemployment is more than 80 percent, and per capita income is less than \$4,000 a year.

We were looking for Jaylene Quick Bear. Tomasz had earlier met her common-law husband, Charles, a full-blooded Lakota who traveled the country conducting traditional spiritual ceremonies such as sun dances and sweat lodges. Jaylene lived in Wanblee, not so



Elvis's ghost and a young Uncle Sam beckon on Fremont Street, the canopy-covered casino district



LAS VEGAS, NEVADA

of downtown Las Vegas. "In Vegas," says Tomaszewski, "good taste means one's own taste."



SAN FRANCISCO, CALIFORNIA

I felt lighter of spirit . . . as if by plunging into

much a town as a run-down federal housing project in the middle of nowhere. Children climbed in and out of ground-floor windows.

Jaylene was making bread when we arrived. Kids (she is raising 14) exploded from her house, laughing, fighting, asking me for piggy-back rides. She invited us to sit under a home-made canopy of pine boughs that shaded her yard. Talking quietly and with a surprising lack of bitterness, she sketched the hardships of living on the reservation.

"You've got to be someone's relative to get a job. They want us women to work, but there are no jobs, and we don't know what kind of people will care for our children." At school, she said, her children were discouraged from speaking their own language, and when they took part in their father's ceremonies, other children accused them of practicing witchcraft.

Jaylene played us a tape of Charles speaking

before a recent sweat lodge, which combines the purification of a sauna with prayers for healing. "The ceremony will give you a stronger heart, a stronger mind, stronger lungs, and stronger blood," Charles said.

"It's hard to walk on this Earth with all these children," Jaylene said, "but I do the sweat lodges. I'll survive." Yet the toughness of her life was taking its toll: At 38, she had no teeth left.

Depressed and angry, we drove back to the Badlands. At a scenic overlook, a woman called to me, "Watch out, there's a rattlesnake around." I felt like a snake, ready to bite.

THUMBING BACK across the upper Midwest, I thought about the serendipity of hitchhiking—so many who had picked me up when, if everything had gone according to their original plan, they wouldn't even have been on that road at that

"Americans seem obsessed with their freedom of expression," says Tomaszewski, "and these guys on Castro Street (above) are the First Amendment in clothing." Things were simpler in Mount Rainier National Park (right), one of many places he found "not yet cannibalized by progress. America's size is its salvation."

time. It felt as if in some way beyond my understanding I was being looked after. By the time I reached the maples and shabby white wooden houses of upstate New York, I had been given 38 rides and had traveled more than 8,000 miles by car, bus, train, foot, subway, taxi, and streetcar. If hitchhiking—putting oneself at the mercy of strangers—is a barometer of goodwill, then surely America is not the violent place it often appears to be on the nightly news.

When I got off the ferry on the Vermont shore of Lake Champlain, a pickup heading in the opposite direction turned around and stopped. The driver's name was Robert Stowell. "I was supposed to paint someone's porch today," he said, and then, with studied Yankee understatement, "but with this rain and cold wind, well, I might have to take it easy."

Stowell looked like the classic Vermont farmer, with his overalls and thin, weathered face, but as always my preconception was wrong. He grew up in Clyde, New York, had

been in the Navy, and had worked as an engineer for 26 years, which, he said, had left him pretty comfortable fixing things. His wife, Shirley, worked at the local post office. "We're kind of reserved. She does her crocheting or knitting. I play around with the computer, or I work in this little woodshop I've set up. She lets me do what I like, cooking, baking, working in the garden, cleaning up around the house."

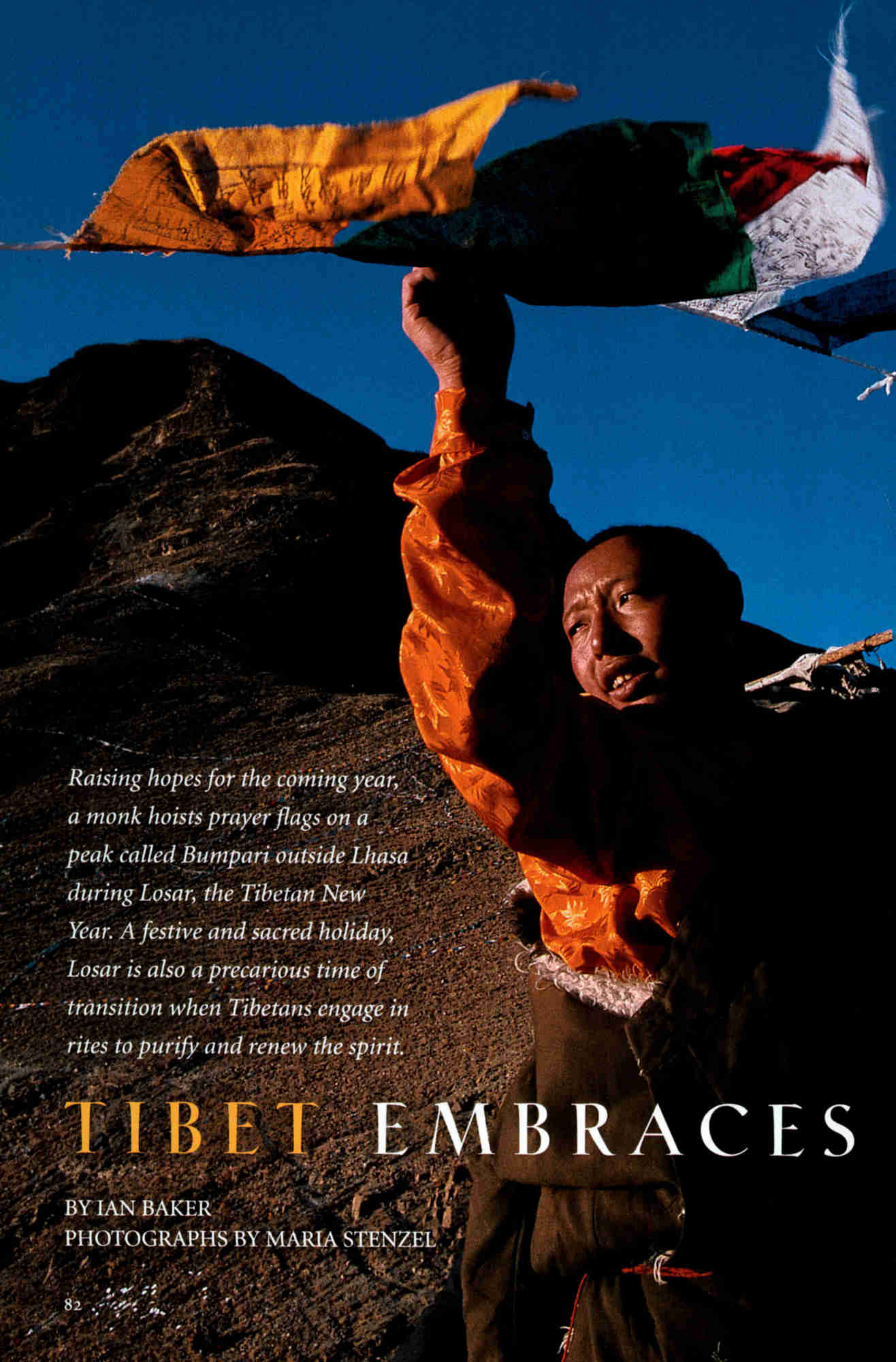
There was something very reassuring about this vision of the settled New England life and a peaceful, dignified, frugal old age. Above all Stowell was a reminder that America is made up of ordinary, remarkable people, fixing things and trying to make things grow, often against the odds.

And decent. He drove 15 miles out of his way—"Heck, I didn't have anything better to do today anyway"—and dropped me off right at the top of my driveway, where the garden, after a month of neglect, was badly in need of weeding. □

America I had plunged into life itself.



MOUNT RAINIER, WASHINGTON

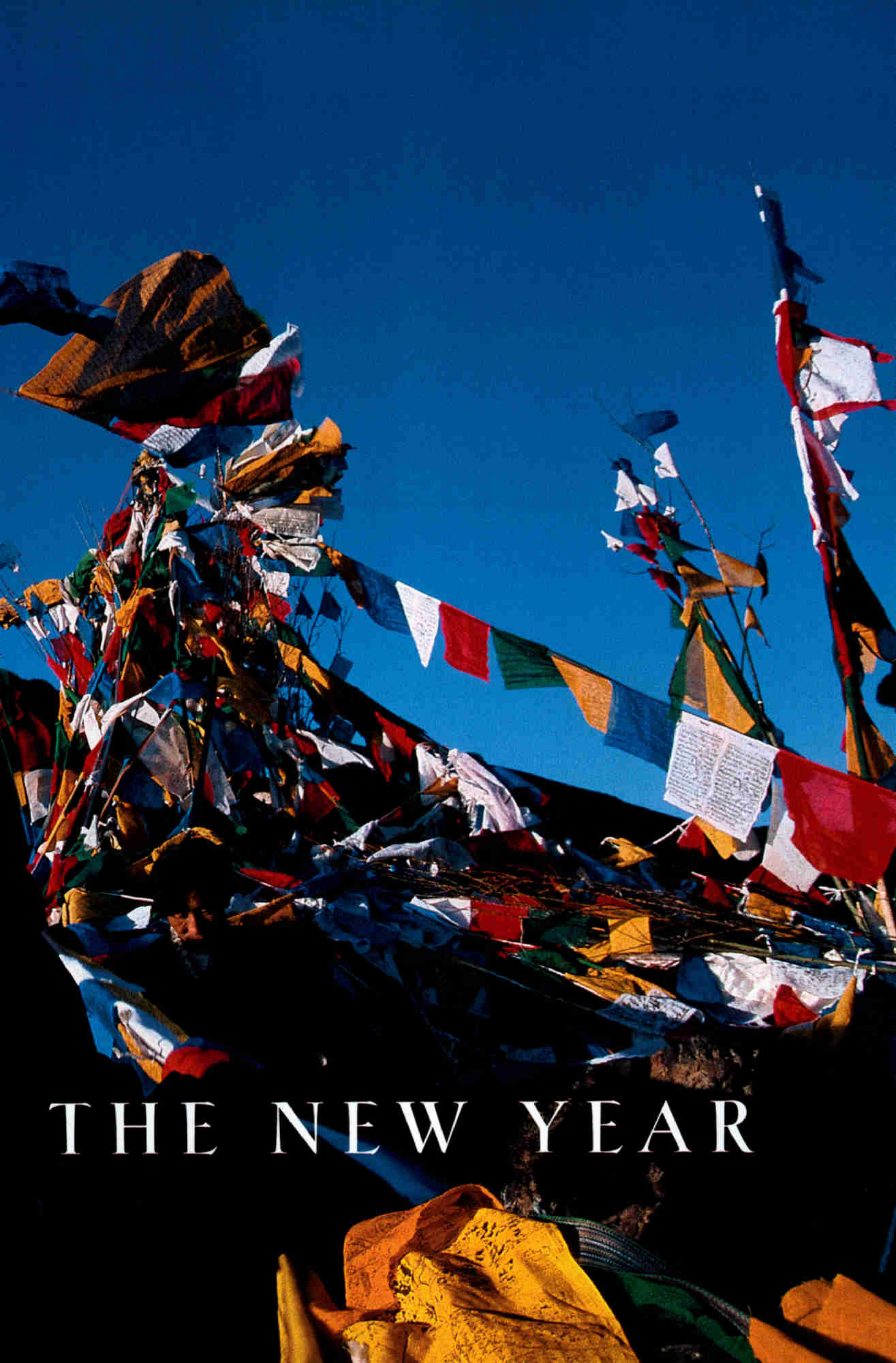


Raising hopes for the coming year, a monk hoists prayer flags on a peak called Bumpari outside Lhasa during Losar, the Tibetan New Year. A festive and sacred holiday, Losar is also a precarious time of transition when Tibetans engage in rites to purify and renew the spirit.

TIBET EMBRACES

BY IAN BAKER

PHOTOGRAPHS BY MARIA STENZEL



THE NEW YEAR

Khampa clansmen from eastern Tibet swaggered through the streets of Lhasa, Tibet's ancient capital, in fox-fur hats and robes trimmed with leopard and otter skin. Bright-

cheeked nomad girls, their hair braided with turquoise, amber, and coral, walked alongside leather-jacketed entrepreneurs with cell phones pressed against their ears. Although I have lived among Tibetans in Nepal for many years, I had never experienced the Tibetan New Year in their homeland, and I was delighted by the energy swirling all around me.

For three days Tibetans of all ages and backgrounds lighted lamps and offered prayers at shrines and monasteries, feasted and gambled with friends and relatives, and consumed liberal quantities of freshly brewed *chang*—an intoxicating liquor made from fermented barley. From rooftops throughout the city the purifying smoke of juniper, artemisia, and other fragrant herbs streamed into the winter sky as offerings to Buddhist deities.

As calculated by astronomers, the 1999 Tibetan lunar year began with the new moon on February 16. Some years, inauspicious conjunctions of planets cause Tibetans to delete entire months from the calendar or to add additional ones. In those cases Losar,

as the New Year period is called, may fall as much as a month earlier or later on the Western calendar. Whenever it occurs, Tibetans believe that both negative and positive actions

performed during Losar reverberate through the year to come. It is a time of karmic opportunity as well as danger, when many rituals are performed—both secular and religious—to ensure prosperity and well-being in the months ahead. West (Continued on page 92)



Kathmandu-based writer IAN BAKER led an expedition sponsored by the Society into Tibet's Tsangpo River Gorge in 1998. MARIA STENZEL has photographed remote places around the world, from the heights of the Andes to Antarctica's Dry Valleys.



For good or ill, actions during Losar are believed to influence the coming year. Pilgrims in Lhasa toss incense and printed prayers into an offering burner in front of the Jokhang, Tibet's most important temple. A mother and daughter earn spiritual merit by prostrating themselves after every two steps as they circle the old city on a pilgrim's circuit.



A

fter a seven-hour climb up a limestone cliff above the Terdrom nunnery north of Lhasa, Lama Osel Lhundrup Dorje guides a line of nuns and porters to a sacred cave at an elevation of more than 16,000 feet (right). Here the lama, who follows an esoteric tantric tradition, will meditate from the new moon in February, the beginning of the New Year, until the full moon—a period when the spiritual impact of such practices is believed to be magnified.

His disciple Ani Riksang, a nun who once spent seven




years in solitary retreat, joins him in an inner chamber of the cave (above), which is reached only by climbing a series of ladders and crawling through a steep tunnel. In this chamber more than a thousand years ago a Tibetan queen, Yeshe Tsogyal, is said to have attained enlightenment.

During the first 15 days of the New Year many Tibetan families commission monks and nuns to recite sacred texts thought to bring prosperity and well-being to their households and villages. Chanting from 10 a.m. to 10 p.m., these lamas (right) from the Rongbuk Valley read from an ancient collection of Buddhist invocations.







A photograph showing a person crawling on the floor beneath a wooden shelf. The shelf is filled with numerous red-bound Buddhist scriptures. The person is in a low, crawling position, their head and back visible. The floor is made of rough, uneven stones. The scene is dimly lit, with a strong light source from the left creating a bright area on the floor and the person's back. The text is overlaid in the upper right corner.

*Hoping to absorb the wisdom of
Buddhist scriptures without reading
them, pilgrims traditionally crawl
beneath stacks of sacred texts at
Pelkor Chode monastery in Gyangze.*

B

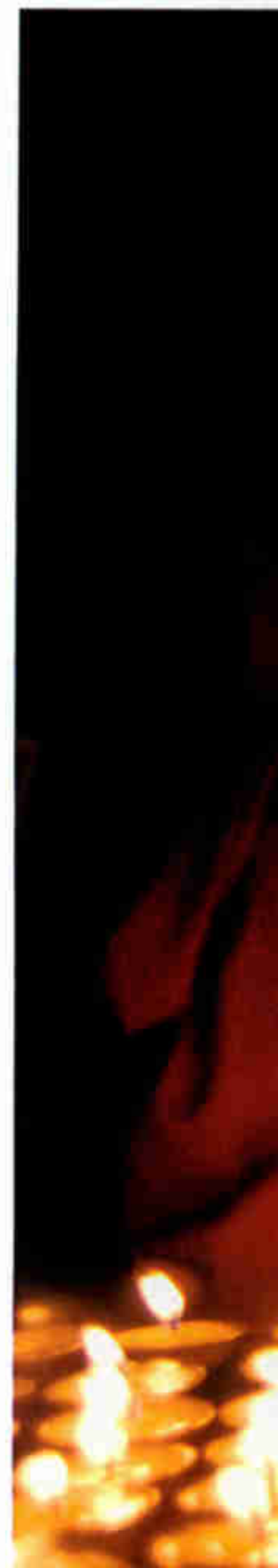
alloons and a holiday spirit ascend the steep slopes of Bumpari, high above the Lhasa Valley. At the summit, dressed in their finest clothes, Khampa clansmen from eastern Tibet will greet the New Year by stringing prayer flags and burning fragrant herbs in carefully tended fires.

Underlying this ritual—as well as all other aspects of Losar—are the Buddhist ideals of wisdom and compassion, which are personified by the colossal figure of Maitreya, Buddha of Loving Kindness, at the Tashi Lhunpo monastery



in Xigaze. Gilded with 615 pounds of gold, the 85-foot-high bronze statue points toward an enlightened future, symbolized by the Wheel of Dharma, or sacred teaching, imprinted on the Buddha's palm.

The statue is a central icon at Tashi Lhunpo, where monks light lamps in the monastery's main chanting hall. The monks pray for the welfare of all sentient beings but particularly for the Panchen Lama, a young boy believed to be the 11th reincarnation of the monastery's abbot. After the Dalai Lama, the Panchen Lama is revered as Tibet's most important spiritual leader.





of Lhasa at Tsurphu monastery, I watched black-hatted monks spin on the soles of their yak-hide boots in a ceremony that has remained unchanged for centuries. As cymbals clashed and horns droned, the monks danced to dispel the accumulated negativity of the past 12 months and to open the way for the year to come. Pressed against the walls of the courtyard, pilgrims in fur-lined robes and richly colored brocades witnessed this timeless drama about the transformation of turbulent psychic forces into the energies of compassion. As the sun disappeared behind a rock ridge, the ceremony concluded with the burning of a menacing effigy, freeing the days ahead from bondage to the past.

"This last year was tricky," said Gyaltsen, a Tibetan trader. "It was the Year of the Tiger, and at its tail end the best laid plans might be brushed aside." He swept his hand through the air as if it were the tail of a great cat. Outside Lhasa on the final day of Losar, along with hundreds of other pilgrims, we were climbing the steep slope of a pyramidal peak called Bumpari—"vase mountain"—to raise prayer flags and offer fragrant herbs pleasing to the spirits of land and sky.

The mountain was of course here long before the temples of Lhasa, Gyaltsen said. Here offerings can reach the gods. At the summit we threw bundles of juniper twigs into a smoldering fire and strung our prayer flags between two granite spires. In the strong wind, one end of the string broke free from its anchor and ascended into the sky.

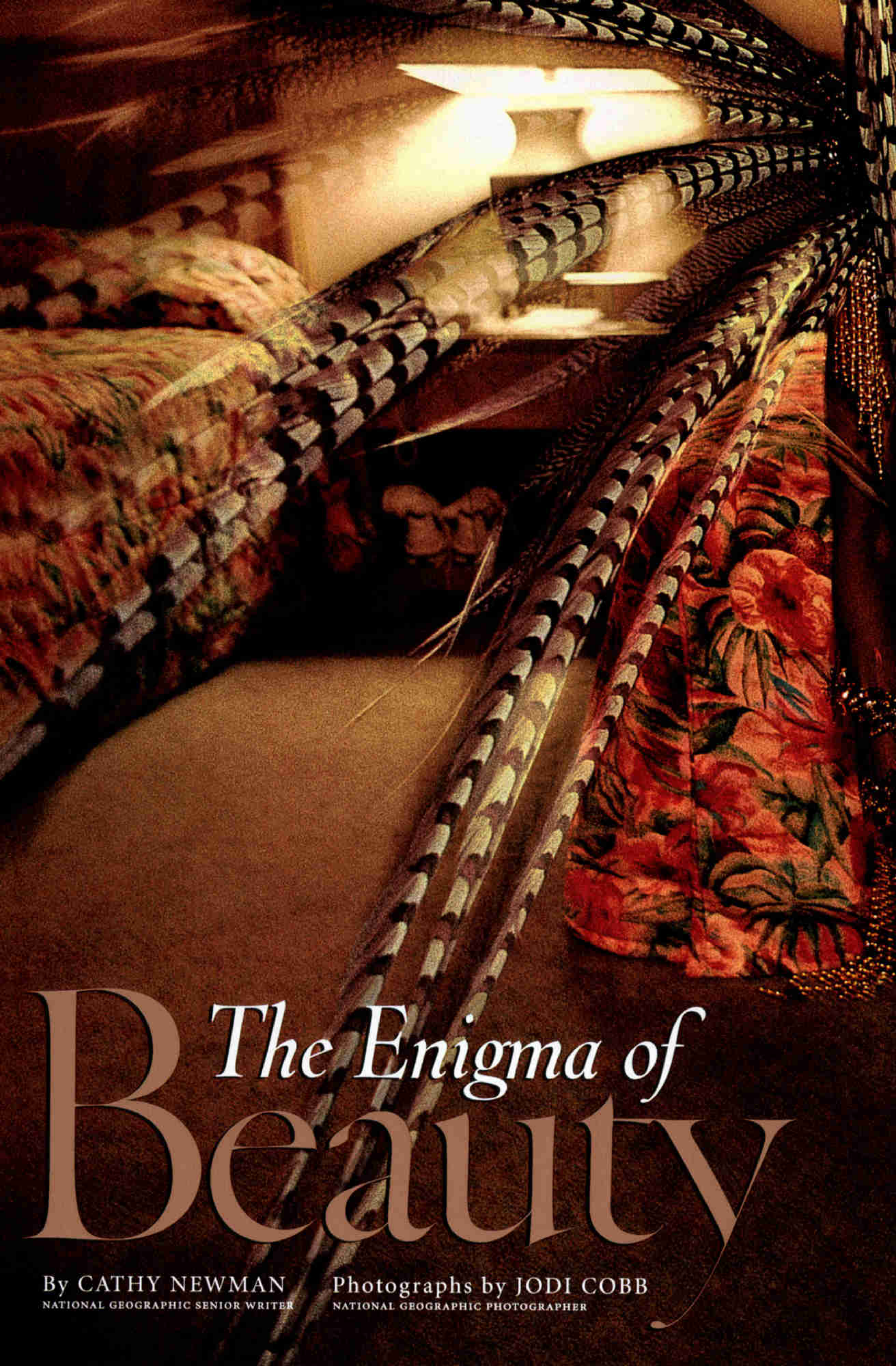
Far below, the last rays of the old year gilded the roofs of the Potala—home to the 14th Dalai Lama before his flight into exile in 1959. Lhasa, literally "land of the gods," has changed much in the 50 years since China imposed its rule on this Buddhist kingdom. At that moment, however, with prayer flags and the songs of pilgrims rising in the windy light, Tibet seemed a place where the human spirit had triumphed.

Gyaltsen flashed his gold tooth. It was late, and Lhasa was thousands of feet below us. With a final invocation, "*Lha gyal lo!*—May the gods be victorious!" we plunged through the deepening shadows, weaving our way with the last of the pilgrims down scree-filled gullies and frozen slopes of grass. Another year and another world were waiting below. □



Dancing away the old year's negative forces, monks at Tsurphu monastery in central Tibet usher in the New Year. Dressed as sorcerers in black hats and splendid robes, the monks dramatize the defeat of ignorance, greed, and aggression, while pilgrims bundled against winter winds look on, enthralled by this annual rite of renewal.





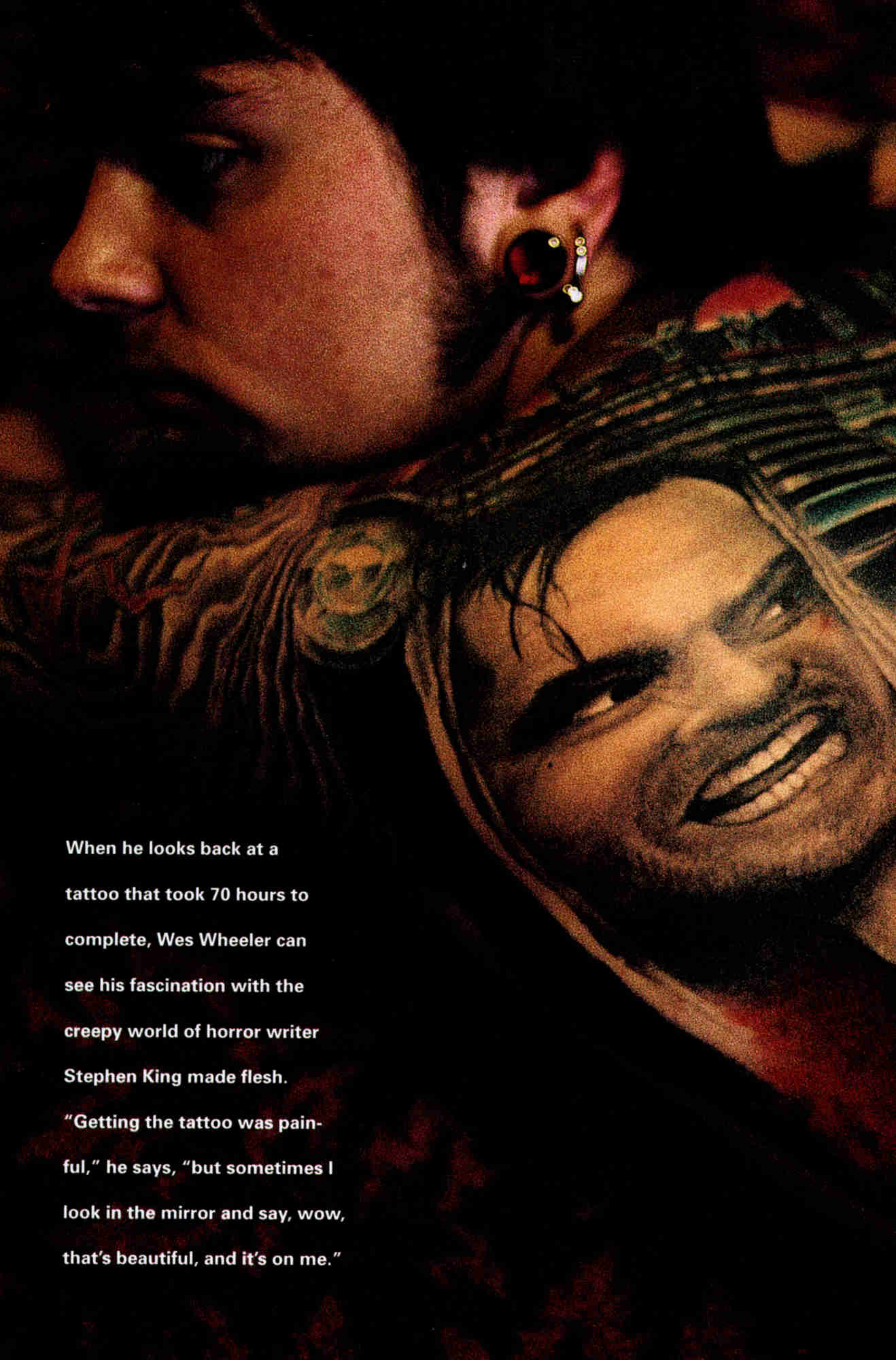
The Enigma of Beauty

By CATHY NEWMAN
NATIONAL GEOGRAPHIC SENIOR WRITER

Photographs by JODI COBB
NATIONAL GEOGRAPHIC PHOTOGRAPHER



Hours before she is crowned Miss Universe 1998, law student Wendy Fitzwilliam of Trinidad gives her national costume a tiny tweak. Lesser mortals reach farther—and more strenuously—in an age-old quest to embody a beauty ideal as enticing as it is elusive.

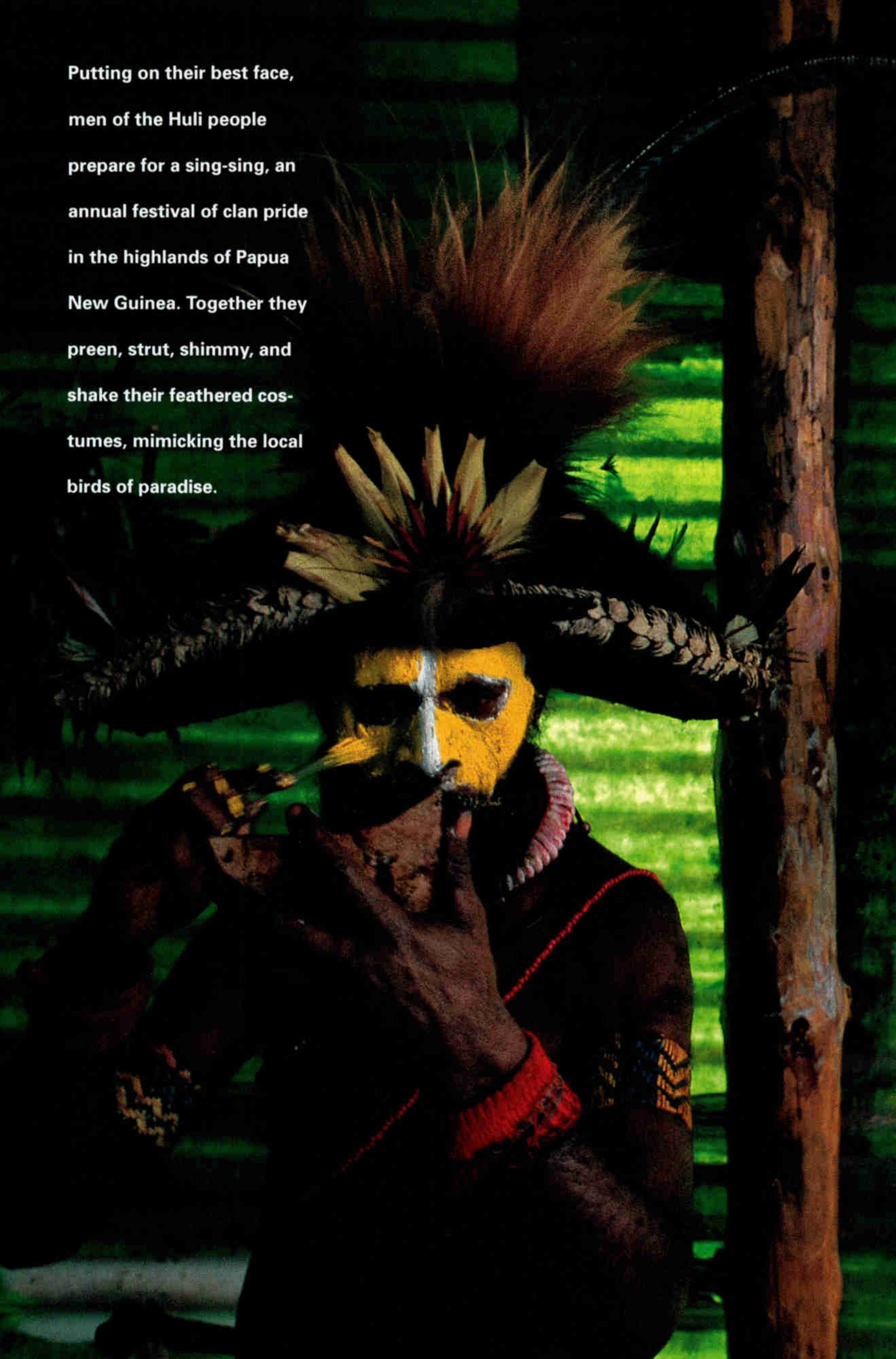


When he looks back at a tattoo that took 70 hours to complete, Wes Wheeler can see his fascination with the creepy world of horror writer Stephen King made flesh.

"Getting the tattoo was painful," he says, "but sometimes I look in the mirror and say, wow, that's beautiful, and it's on me."



Putting on their best face,
men of the Huli people
prepare for a sing-sing, an
annual festival of clan pride
in the highlands of Papua
New Guinea. Together they
preen, strut, shimmy, and
shake their feathered cos-
tumes, mimicking the local
birds of paradise.





Beauty

The Enigma of

SHELI JEFFRY is searching for beauty. As a scout for Ford, one of the world's top model agencies, Jeffry scans up to 200 young women every Thursday afternoon. Inside agency headquarters in New York, exquisite faces stare down from the covers of *Vogue*, *Glamour*, and *Harper's Bazaar*. Outside, young hopefuls wait for their big chance.

Jeffry is looking for height: at least five feet nine. She's looking for youth: 13 to 19 years old. She's looking for the right body type.

What is the right body type?

"Thin," she says. "You know, the skinny girls in school who ate all the cheeseburgers and milk shakes they wanted and didn't gain an ounce. Basically, they're hangers for clothes."

In a year, Jeffry will evaluate several thousand faces. Of those, five or six will be tested. Beauty pays well. A beginning model makes \$1,500 a day; those in the top tier, \$25,000; stratospheric supermodels, such as Naomi Campbell, four times that.

Jeffry invites the first candidate in.

"Do you like the camera?" she asks Jessica from New Jersey.

"I love it. I've always wanted to be a model," Jessica says, beaming like a klieg light.

Others seem less certain. Marsha from California wants to check out the East Coast vibes, while Andrea from Manhattan works on Wall Street and wants to know if she has what it takes to be a runway star. (Don't give up a sure thing like a well-paying Wall Street job for this roll of the dice, Jeffry advises.)

The line diminishes. Faces fall and tears well as the refrain "You're not what we're looking for right now" extinguishes the conversation—and hope.

You're not what we're looking for. . . .

Confronted with this, Rebecca from Providence tosses her dark hair and asks: "What are you looking for? Can you tell me exactly?"

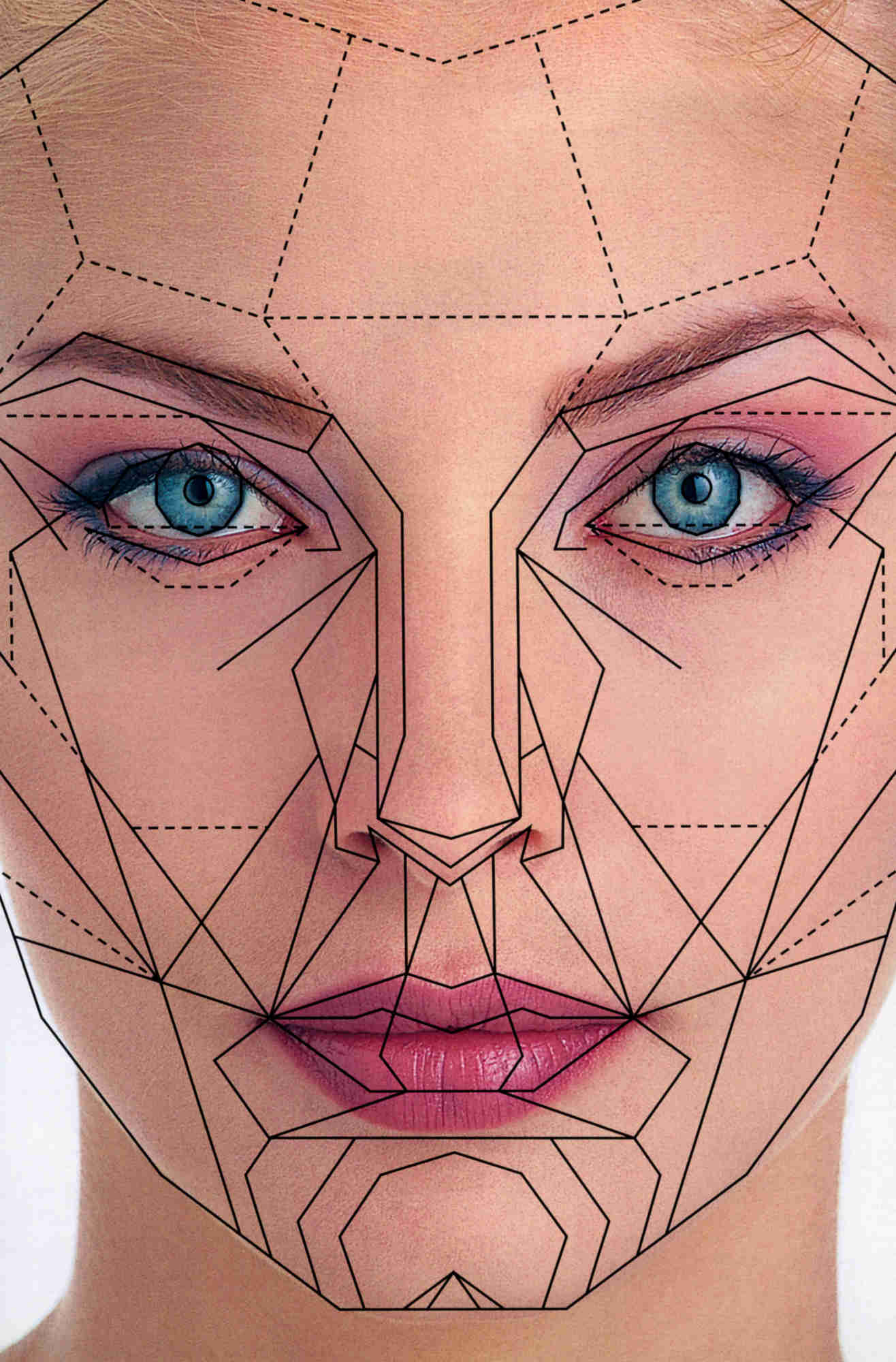
Jeffry meets the edgy, almost belligerent, tone with a composed murmur. "It's hard to say. I know it when I see it."

WHAT IS BEAUTY? We grope around the edges of the question as if trying to get a toe-hold on a cloud.

"I'm doing a story on beauty," I tell a prospective interview. "By whose definition?" he snaps.

Define beauty? One may as well dissect a soap bubble. We know it when we see it—or so we think. Philosophers frame it as a moral equation. What is beautiful is good, said Plato. Poets reach for the lofty. "Beauty is truth, truth beauty," wrote John Keats, although Anatole France thought beauty "more profound than truth itself."

Behold the proportions of the ideally attractive face, as seen by plastic surgeon Stephen Marquardt. Guided by the idea of a "golden ratio" and by the contours of some admired faces, he built this beauty mask. Critics say it obscures the truth by quantifying the unquantifiable.





It's a feast for the eyes back-stage at the finals of the Elite Model Look competition in Nice, France. Some 350,000 girls from 55 countries compete in this search, which helps satisfy the advertisers and fashion mavens with their never ending demands for a new look, a fresh face.





Straight out of the womb, does a newborn baby stare at an “attractive” face longer than an “unattractive” one? Probably not, says developmental psychologist Lisa Kalanik, although research indicates that older infants do. Psychologist Devendra Singh modified the waist-to-hip ratio of seven Barbies in a study to determine how body shape influences perceptions of attractiveness. Subjects preferred Barbie G.

Others are more concrete. “People come to me and say: ‘Doctor, make me beautiful,’” a plastic surgeon reveals. “What they are asking for is high cheekbones and a stronger jaw.”

Science examines beauty and pronounces it a strategy. “Beauty is health,” a psychologist tells me. “It’s a billboard saying ‘I’m healthy and fertile. I can pass on your genes.’”

At its best, beauty celebrates. From the Txikão warrior in Brazil painted in jaguar-like spots to Madonna in her metal bra, humanity revels in the chance to shed its everyday skin and masquerade as a more powerful, romantic, or sexy being.

At its worst, beauty discriminates. Studies suggest attractive people make more money, get called on more often in class, receive lighter court sentences, and are perceived as friendlier. We do judge a book by its cover.

We soothe ourselves with clichés. It’s only skin-deep, we cluck. It’s only in the eye of the beholder. Pretty is as pretty does.

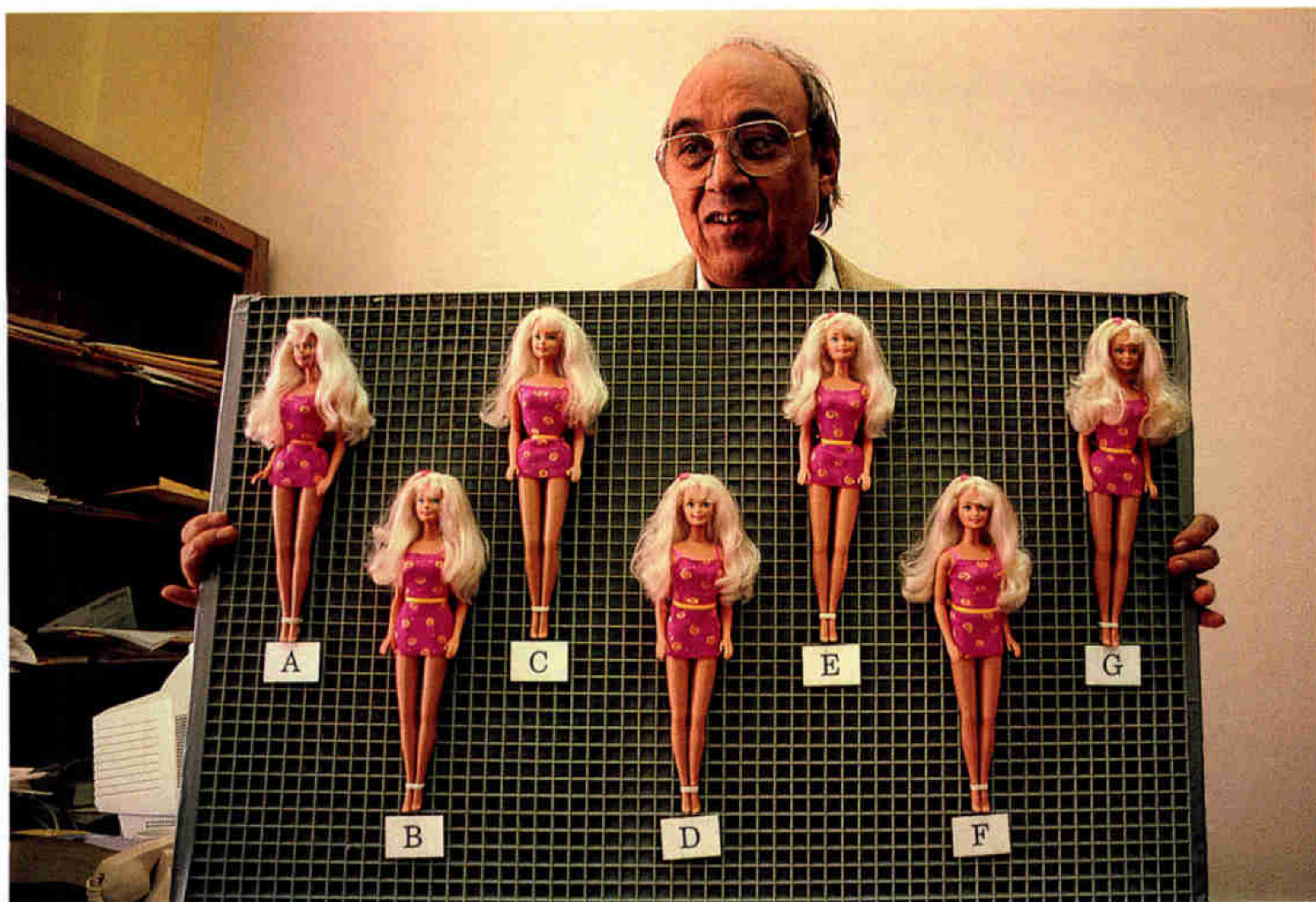
In an era of feminist and politically correct

values, not to mention the closely held belief that all men and women are created equal, the fact that all men and women are not—and that some are more beautiful than others—disturbs, confuses, even angers.

For better or worse, beauty matters. How much it matters can test our values. With luck, the more we live and embrace the wide sweep of the world, the more generous our definition becomes.

Henry James met the English novelist George Eliot when she was 49 years old. *Silas Marner*, *Adam Bede*, and *The Mill on the Floss* were behind her. *Middlemarch* was yet to come.

“She is magnificently ugly,” he wrote his father. “She has a low forehead, a dull grey eye, a vast pendulous nose, a huge mouth, full of uneven teeth. . . . Now in this vast ugliness resides a most powerful beauty which, in a very few minutes, steals forth and charms the mind, so that you end as I ended, in falling in love with her.”



In fairy tales, only the pure of heart could discern the handsome prince in the ugly frog. Perhaps we are truly human when we come to believe that beauty is not so much in the eye, as in the heart, of the beholder.

THE SEARCH FOR BEAUTY spans centuries and continents. A relief in the tomb of the Egyptian nobleman Ptahhotep, who lived around 2400 B.C., shows him getting a pedicure. Cleopatra wore kohl, an eyeliner made from ground-up minerals.

Love of appearance was preeminent among the aristocracy of the 18th century. Montesquieu, the French essayist, wrote: "There is nothing more serious than the goings-on in the morning when Madam is about her toilet." But monsieur, in his wig of cascading curls, scented gloves, and rouge, was equally narcissistic. "They have their color, toilet, powder puffs, pomades, perfumes," noted one lady socialite, "and it occupies them just as much as or even more than us."

The search for beauty could be macabre. To emphasize their noble blood, women of the court of Louis XVI drew blue veins on their necks and shoulders.

The search for beauty could be deadly. Vermilion rouge used in the 18th century was made of a sulfur and mercury compound. Men and women used it at the peril of lost teeth and inflamed gums. They sickened, sometimes died, from lead in the white powder they dusted on their faces. In the 19th century women wore whalebone and steel corsets that made it difficult to breathe, a precursor of the stomach-smooshing Playtex Living Girdle.

The search for beauty is costly. In the United States last year people spent six billion dollars on fragrance and another six billion on makeup. Hair- and skin-care products drew eight billion dollars each, while fingernail items alone accounted for a billion. In the mania to lose weight 20 billion was spent on diet products and services—in addition to the billions that were paid out for health club memberships and cosmetic surgery.

Despite the costs, the quest for beauty prevails, an obsession once exemplified by the taste of Copper Eskimo women for a style of boot that let in snow but was attractive to men because of the waddle it inflicted on the wearer—a fashion statement not unlike the ancient Chinese custom of foot binding or the 20th-century high heel shoe.



I AM STANDING behind a one-way mirror watching a six-month-old baby make a choice. The baby is shown a series of photographs of faces that have been rated for attractiveness by a panel of college students. A slide is flashed; a clock ticks as the baby stares at the picture. The baby looks away; the clock stops. Then it's on to the next slide.

After more than a decade of studies like these, Judith Langlois, professor of psychology at the University of Texas in Austin, is convinced that this baby, like others she has tested, will spend more time looking at the attractive faces than the unattractive ones.

What's an attractive face? It's a symmetrical face. Most important, it's an averaged face, says Langlois. Averaged, that is, in terms of

position and size of all the facial features. As the slides flash in front of the baby, I see what she means. Some faces are more pleasing to look at than others. It's a question of harmony and the placement of features. The picture of the young girl with wide-set eyes and a small nose is easier on the eye than the one of the young girl with close-set eyes and a broad nose. Extremes are off-putting and generally not attractive, Langlois says.

The idea that even babies can judge appearance makes perfect sense to Don Symons, an anthropologist at the University of California at Santa Barbara.

"Beauty is not whimsical. Beauty has meaning. Beauty is functional," he says. Beauty, his argument goes, is not so much in the eye as in the brain circuitry of the beholder.



To keep an eye on the latest styles, the fashion press convenes in New York City each spring for a week of designer shows. At one, Isabel Toledo presented a white cotton shift (\$450) paired with Manolo Blahnik stiletto heels (\$850) and the body of Nicole Anderson (\$750 an hour). “We wanted a superconfident, very sensual look, and stilettos make the girls walk beautifully,” says Ruben Toledo, Isabel’s husband and business partner. “They don’t feel important in flats.”

In studies by psychologists such as Victor Johnston at New Mexico State University and David Perrett at St. Andrews University in Scotland, men consistently showed a preference for women with larger eyes, fuller lips, and a smaller nose and chin. Studies by psychologist Devendra Singh at the University of Texas show a preference for the classic hourglass-shaped body with a waist-hip ratio of seven to ten.

“That men prefer women with smooth skin, big eyes, curvaceous bodies, and full lips is anything but random,” Symons insists. All these traits are reliable cues to youth, good health, and fertility. Take lips, which, plumped up by estrogen, reach their fullness at 14 to 16 when women enter the fertile stage of their life. With menopause and the loss of fertility,

lips lose their fullness. Likewise lesions or sores on the skin signal the presence of infectious disease or parasites. Clear, smooth skin speaks of youth and good health.

In the scenario envisioned by Symons and other evolutionary scientists, the mind unconsciously tells men that full lips and clear skin equal health, fertility, and genetic soundness. It’s an instinct honed over a hundred thousand years of selection, Symons believes. Because we are mortgaged to our evolutionary history, the instinct persists.

Not everyone agrees. “Our hardwiredness can be altered by all sorts of expectations—predominantly cultural,” says C. Loring Brace, an anthropologist at the University of Michigan. “The idea that there is a standard desirable female type tells you more about the libidinous fantasies of aging male anthropologists than anything else.”

Douglas Yu, a biologist from Great Britain, and Glenn Shepard, an anthropologist at the University of California at Berkeley, found that indigenous peoples in southeast Peru preferred shapes regarded as overweight in Western cultures: “A fuller evolutionary theory of human beauty must embrace variation,” Yu says.

To think you’ve found a cultural universal is thrilling, says Elaine Hatfield, professor of psychology at the University of Hawaii, “but you don’t want to deceive yourself into thinking that biology accounts for everything. The sociobiologists say we’re trapped in our Pleistocene brains. The idea can be slightly bullying, as well as chauvinistic.”

What about those who are not so symmetrical or well formed? Is anyone immune to feelings of inadequacy? Eleanor Roosevelt was once asked if she had any regrets. Only one, she said. She wished she had been prettier.

I knew I was an ugly baby when my parents gave me an electric toaster as a bathtub toy. . . . The joke is told by Joan Rivers, so I call her up—she lives in New York these days—to ask if the humor isn’t just a little too dark.

“I always wonder what my life would have been if I had had that wonderful ingredient called beauty,” the unmistakable raspy voice responds.

“Marilyn Monroe said to a friend of mine, ‘I knew I had power when I was eight.



A haircut, a dye job, maybe a bit of blush—the choice is made not by aspiring models (above) but by beauty experts at a competition in New York. In Buenos Aires, Dr. José Juri prepares to perform a face-lift and a nose job, two of roughly 2,000 procedures he does each year. In the United States in 1998 doctors performed 47,000 cosmetic procedures—including breast implantation and liposuction—on teenagers alone.

I climbed a tree and four boys helped me down.'

"On the other hand, not being pretty gave me my life. You find other ways. It made me funny. It made me smarter. I wasn't going to get into college as Miss Cheerleader."

There's a hint of wistful in the voice. "Beauty is based on youth and on a certain look. When you're old, you're invisible. No matter how they lie to us and tell us Barbra Streisand is beautiful, if you woke up without her enormous talent would you rather look like her or Michelle Pfeiffer?"

IN THE WORLD OF BEAUTY there are many variations on a theme, but one thing seems clear. Every culture has its bad hair day. In central Australia balding Aranda Aborigines once wore wigs made of emu feathers. Likewise, the Azande in Sudan wore wigs made of sponge. To grow long hair among the Ashanti in Nigeria made one suspect of contemplating

murder, while in Brazil the Bororo cut hair as a sign of mourning.

Hair has other shades of meaning. Although the archetypal male hero in Western civilization is tall, dark, and handsome like Cary Grant, blond women have sometimes been imagined as having more fun.

Blond is the color of fairy-tale princesses like Cinderella and Rapunzel, not to mention the siren in *Farewell, My Lovely*, of whom Raymond Chandler wrote: "It was a blonde. A blonde to make a bishop kick a hole in a stained glass window."

Jean Harlow was a blonde. So were Carole Lombard and Marilyn Monroe (only their hairdressers knew for sure), who said she liked to "feel blond all over." A dark-haired colleague admits to "blonde anxiety," adding her observation that in California blondes have blonde insecurity. "They don't feel they're blond enough."

Hair-care product companies estimate that in the U.S. 40 percent of women who



color their hair choose blond, a choice women also made in ancient Greece. From a biological perspective some researchers say blondness suggests a childlike appearance. Many newborns are blond and darken with time.

What other signals does hair send? In most societies, short hair means restraint and discipline: Think West Point, Buddhist monks, and prison. Long hair means freedom and unconventional behavior: Think Lady Godiva and Abbie Hoffman. Hair says I'm grown-up, and let's get that first haircut. It's the stages of life, from pigtails to ponytail to gray hair.

"This is what I looked like at age five," Noliwe Rooks, a visiting assistant professor of history and African-American studies at Princeton, tells me.

We're at her dining table drinking tea and talking about hair—specifically African-American hair—and how it defines culture, politics, and the tension between generations. The photograph she shows me is of a little girl with a big puff ball of an Afro staring up at the camera.

"My mother was a political activist, and so I wore my hair like this until I was 13," Rooks says, smiling.

"My grandmother had this huge issue with it. I was her only grandchild, and she couldn't

stand it. It wasn't cute. It wasn't feminine. You couldn't put little bows in it. Every summer my mother would take me down to Florida to stay with her. As soon as my mother left, my grandmother would take me to Miss Ruby's beauty parlor and straighten my hair. Issues between my mother, my grandmother, and me got worked out around my hair."

While in college Rooks decided to let her hair "lock," or grow into a mass of pencil-thin dreadlocks.

"Before I was able to tell my grandmother, she had a stroke. I found myself on a plane flying to her bedside, rehearsing how I was going to explain the locks. The doctors didn't know the extent of the damage. She hadn't spoken. All she could make were garbled sounds. I couldn't wear a hat to hide my hair. It was Florida. It was 80 degrees. I walked into her hospital room, expecting the worst, when all of a sudden she opened her eyes and looked at me.

"What did you do to your hair?" she said, suddenly regaining the power of speech."

After her grandmother died, Rooks found herself in front of the mirror cutting her hair in a gesture of mourning.

"When my grandmother was in the hospital, I'd brushed her hair. I pulled the gray hairs

out of the brush, put them in a plastic bag, and put it in front of her picture. That was hair for me. There was so much about it that defined our relationship. It meant closeness, and then, finally, acceptance.”

GRAVITY TAKES ITS TOLL ON US all. That, along with time, genetics, and environment, is what beauty’s archenemy, aging, is about. “The bones stay upright until you go permanently horizontal,” says Dr. Linton Whitaker, chief of plastic surgery at the University of Pennsylvania Medical Center. “As the soft tissue begins to sag off the bones, the rosy cheeks of childhood become the sallow jowls of the elderly. What was once jawline becomes a wattle.”

Blame the vulnerability of flesh on collagen and elastin—materials found in the second layer of our skin that give it elasticity.

“Collagen under a microscope is like a knit sweater,” Whitaker explains. “After the 10,000th wearing and stretching, it becomes baggy, and the same with skin. When the knit of collagen and elastin begins to fragment, skin loses its elasticity.” Then gravity steps in.

“If aging is a natural process, isn’t there something unnatural about all this surgical snipping and stitching to delay the inevitable?” I ask.

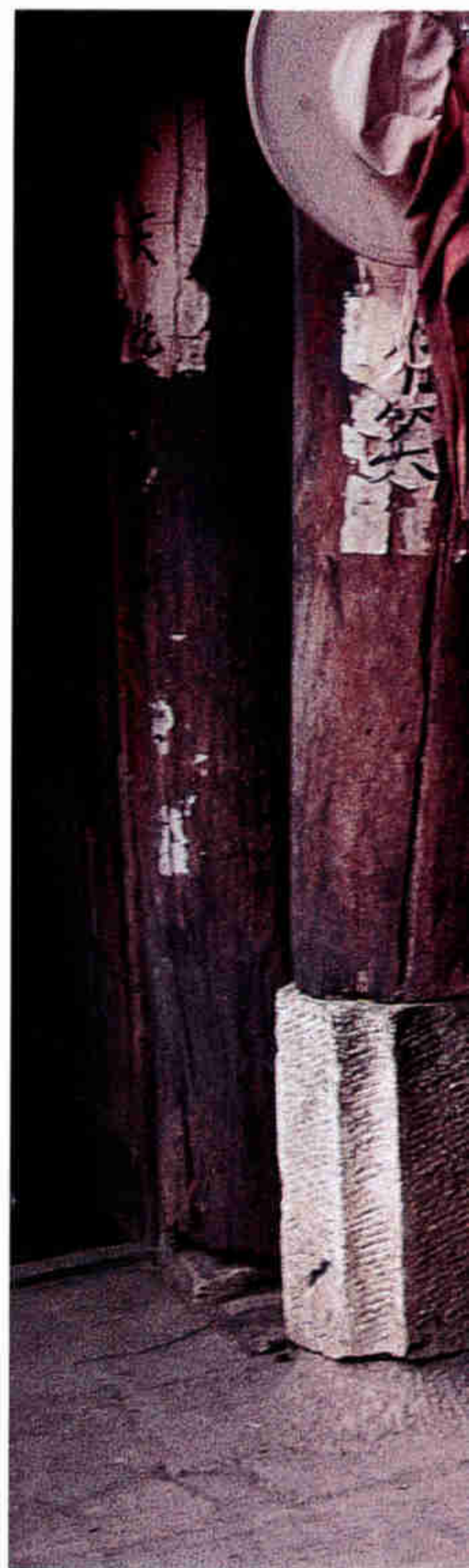
“I guess it’s not natural, but what is?” Whitaker sighs. “It’s the world we live in. Right or wrong, it’s a judgment. But it’s doable and makes people happy.”

It makes many people happy. According to the American Society for Aesthetic Plastic Surgery, almost three million cosmetic procedures were performed in the United States in 1998. Baby boomers (35 to 50) accounted for 42 percent.

The quest for the perfect look is global. In Russia cut-price plastic surgery lures patients from as far away as London and Sydney. In Australia, where a short-lived magazine called *Gloss* trumpeted the glories of cosmetic surgery, penile enlargements are among the six cosmetic procedures most popular with males, along with nose jobs, eyelid lifts, liposuction, face-lifts, and ear corrections.

In China plastic-surgery hospitals are sprouting up faster than bamboo shoots in

A small foot on a woman is a beautiful foot, said an ancient Chinese tradition. That aesthetic led millions of parents, including those of 79-year-old Xiao Xou-Xiang (right), to bind their daughters’ feet. The practice, now illegal, required breaking the arch of the foot, then constricting it, which resulted in a stylized, mincing gait. It also set social constraints. Said one 17th-century writer, “If [girls’] feet are not bound, they go here and there with unfitting associates.”



spring. Patients can check into a 12,000-square-foot palace of plastic surgery called the Dreaming Girl’s Fantasy on Hainan Island.

In Brazil, says Dr. Ivo Pitanguy, a world-famous plastic surgeon, “women get liposuction at 18 and breast reduction at between 16 and 22. They prefer small breasts and big derrieres, whereas Americans want big chests. In the 1970s only 8 percent of my patients were men. Now it’s 25 percent. Today society accepts the idea of improving one’s image.”

The line between self-improvement and neurosis can blur. I hear about a town in Texas where breast augmentations are given as graduation gifts. And how to make sense of singer Michael Jackson with his reported inventory of four nose jobs, a chin implant, eyelid



surgery, a face-lift, lip reduction, skin bleaching, and assorted touch-ups?

(“Michael designed the way he wants to look,” said a source close to the star. “It’s no different from choosing your jewelry, your clothing, or your hairstyle.”)

“Suppose I’m not so cute when I grow up as I am now?” Shirley Temple is said to have asked with some prescience when she was eight. Fret not. What goes down, comes up. For falling hair, Rogaine. For the drooping face, Retin-A. Prozac for the sagging soul and Viagra for the sagging penis.

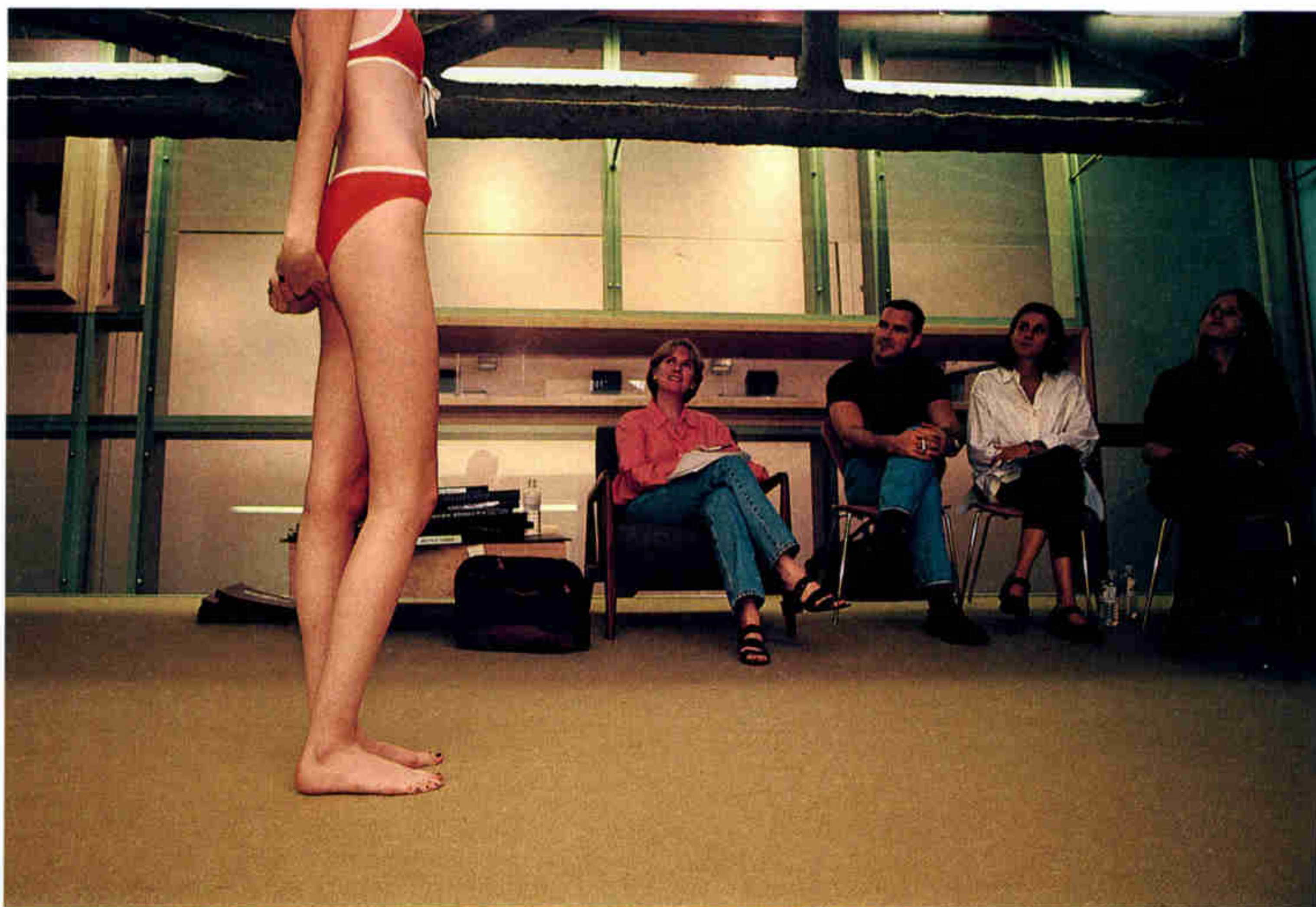
“Old age is not for sissies,” I say to a friend, quoting one of Bette Davis’s favorite lines.

“No, no,” she corrects. “Old age is not for narcissists. If you are wrapped up in yourself, you have nothing but the potential for loss.”

Even non-sissies have trouble with aging. Martha Graham, a powerful woman and possibly the most influential force in modern dance, grew bitter as she grew old. She would call Bertram Ross, one of her dancers, in the middle of the night. “Die while you’re young and still beautiful,” she would hiss into the phone, then hang up.

AT 48, GRAVITY HAS TAKEN its toll on me. I look at the mirror and note the delta of wrinkles starting to branch from the corners of my eyes. My chin has begun to blur into my neck. There is a suggestion of jowliness.

Of course I could consult a plastic surgeon like Dr. Sherwood Baxt. On the day I visit his



A bathing suit bares what matters most at a modeling competition, where judges prefer girls who are 5'9" or taller, leggy, and very thin. Eager to embody this bony ideal, many girls end up suffering from "supermodel syndrome" and life-threatening eating disorders. At a hospital for anorexics and bulimics in Buenos Aires (opposite), doctors urge patients to eat five times a day, hoping to foster a healthier body image.

office in Paramus, New Jersey, Baxt, a tall man with a sweep of graying hair, is dressed in a well-cut charcoal double-breasted suit with a pinstripe shirt, yellow silk tie affixed by a gold safety pin, and a pair of black tasseled calf loafers.

You might say that Baxt, who has not one but three different lasers for sculpting, peeling, and taming the bumps and wrinkles of imperfect flesh, offers one-stop shopping for cosmetic surgery. The centerpiece of his office complex is an operating suite that would be the envy of a small community hospital.

"Plastic surgery is exciting," Baxt tells me in calm, reassuring tones. "We're lifting, tightening, firming. We change people's lives."

"How and why?" I want to know.

"Most of my patients work," he says. "I see a lot of high-power women who can't fit into a suit anymore because of hormonal changes and pregnancies. They're in a competitive world. Liposuction is the most common procedure. The face is the next order

of business—the eyes, double chins. All of that says to the workforce, 'You look a bit tired. You're a bit over the hill. You're having trouble keeping up.'"

Wondering how I'd fare with a nip and tuck of my own, I've asked for a consultation. Thanks to computer imaging, I can get a preview. An assistant takes front and side views of my face with a Polaroid camera and scans them into a computer. As I watch, my face pops up on the screen and then morphs as Baxt manipulates the image. The softness under my chin retracts into firmness; the circles under my eyes disappear; wrinkles smooth out. I'm looking younger—not the hard, stiff, pulled-tight mask-look that screams "face-lift! face-lift!"—but more subtly younger.

"First I did your upper eyelids," Baxt explains, pointing at the screen. "I removed a bit of fatty tissue. I also took off some of the fat pockets over the lower lid, then lasered the skin smooth and tight. Next I did some



liposuction on the wad of fat under the chin and brought the chin forward with an implant. You've got two things going for you: good skin and a full face. You age better if you have a full face. You don't need to be lifted and pulled at this point. Maybe in ten years."

The tab? About nine or ten thousand dollars. Of course my insurance would never pay this bill. It's strictly out-of-pocket. No problem. Baxt offers an installment plan.

Back home, I stare at myself in the mirror. I've always scoffed at plastic surgery. Then 50 loomed into view. Now I'm more tolerant. We are living longer. We are healthier. Today the average life expectancy is 76 years. Fifty years ago it was 68. One hundred years ago it was 48. The face in the mirror doesn't always reflect how old or young we feel.

THE SAD, sometimes ugly, side of beauty: In a 1997 magazine survey, 15 percent of women and 11 percent of men sampled said they'd sacrifice more than five years of their life to be at their ideal weight. Others were prepared to make other sacrifices. One 25-year-old Maryland woman said: "I love children and would love


to have one more—but only if I didn't have to gain the weight."

Is life not worth living unless you're thin?

"Girls are literally weighing their self-esteem," says Catherine Steiner Adair, a psychologist at the Harvard Eating Disorders Center in Boston. "We live in a culture that is completely bonkers. We're obsessed with sylphlike slimness, yet heading toward obesity. According to one study, 80 percent of women are dissatisfied with their bodies. Just think about how we talk about food: 'Let's be really bad today and have dessert.' Or: 'I was good. I didn't eat lunch.'"

In one of its worst manifestations, discontent with one's body can wind up as an eating disorder, such as anorexia, a self-starvation syndrome, or bulimia, a binge-and-purge cycle in which people gorge and then vomit or use laxatives. Both can be fatal.

Today eating disorders, once mostly limited to wealthy Western cultures, occur around the world. "I was in Fiji the year television was introduced," says Dr. Anne Becker, director of research at the Harvard center. "Eating disorders were virtually unknown in Fiji at that time." When she returned three years later, 15 percent of the girls she was studying had tried vomiting to lose weight.



Who cares about having
washboard abs and a
“ripped” body? At a primal
level we all do, say evolution-
ary psychologists, who argue
that a man with a large chest
and narrow waist enjoys
sizable reproductive advan-
tages. Or, in the words of one
gym promo: No pecs, no sex.





Ready to rumble—or at least looking the part—a Huli warrior (above) and a young Asaro mudman glower during a festival in the highlands of Papua New Guinea. “Here men are the objects of beauty,” says anthropologist Nancy Sullivan. “To be masculine is to be well made-up.” Women, though, court danger if they are too attractive, says Sullivan. “Men are already mortally afraid of the power of women’s biology.”

In Japan anorexia was first documented in the 1960s. It now affects an estimated one in one hundred Japanese women and has spread to other parts of Asia, including Korea, Singapore, and Hong Kong. In the U.S., according to the Menninger Clinic in Topeka, Kansas, the proportion of females affected by eating disorders is around 5 to 10 percent.

To say that all women with eating disorders want to look like runway models is to gloss over a complex picture that weaves biology and family dynamics in with cultural influences. One thing can be said: Eating disorders are primarily a disease of women.

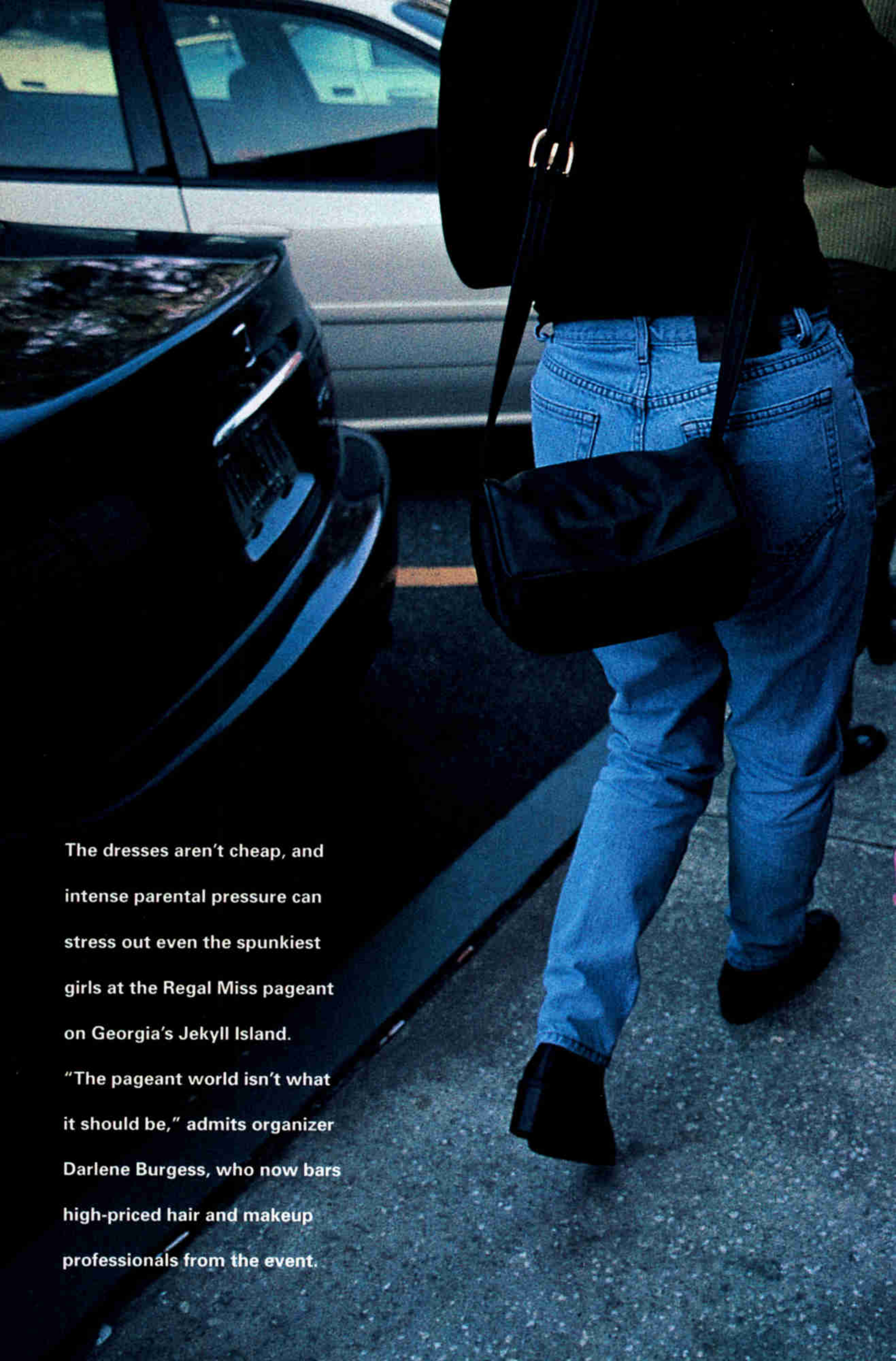
“It’s easy to be oversimplistic in defining causes,” says Emily Kravinsky, medical director at the Renfrew Center in Philadelphia, a treatment center for women with eating disorders. “Some of these women don’t know how to cope or soothe themselves. They have low self-esteem. Also, there’s increasing evidence that biology and genetics play a role. Finally, the distance between the cultural ideal of what

we would like to look like and the reality of what we actually look like is becoming wider. If Marilyn Monroe walked into Weight Watchers today, no one would bat an eye. They’d sign her up.”

Late one winter afternoon at Renfrew I sat in what once was the drawing room of an elegant mansion—it is now a space used for group therapy—and had a conversation with two young women who are patients. The subject was beauty and self-image and how that sometimes goes uncontrollably awry. The two sat next to each other on a sofa, occasionally turning to tease or reassure the other, in the easy, bantering way that friends do. One, a former gymnast, was short and compact and very overweight. The other, a former dancer, was tall, and very, very thin.

“My family moved here so I could attend the gymnastics academy,” said the former gymnast we’ll call Sarah. “I was three years old. Every week they would put us on the scale and call out our weight so everyone could



A person wearing a black long-sleeved shirt, blue jeans, and black shoes is walking from left to right. They are carrying a black bag with a gold-colored buckle. The background shows a silver car and a dark car parked on a street.

The dresses aren't cheap, and intense parental pressure can stress out even the spunkiest girls at the Regal Miss pageant on Georgia's Jekyll Island.

"The pageant world isn't what it should be," admits organizer Darlene Burgess, who now bars high-priced hair and makeup professionals from the event.



hear. By 13, I was anorexic. And then I started eating and couldn't stop. I became bulimic."

"For me it was the mirrors and being in leotards and tights," said the former dancer we'll call Leah. "It was seeing the parts go to the prettier girls. I thought: 'If only I were thinner.'"

It has been a long struggle and will continue to be so, both said. There are no shortcuts in the search for equilibrium of the soul.

"I want a relationship," Leah said wistfully. "I say to myself: You don't have to be thin. Then I open a magazine and see these gorgeously thin women, and they all have a handsome guy next to them. I tell myself, oh, so you do have to be thin."

And yet, despite setbacks and constant self-vigilance, both could finally begin to see the glimmer of another possibility. There are other ideas of beauty, the two agreed.

"Beauty is all the wonderful creative things that a person is, how they handle themselves and treat other people," Sarah said. "My brother has Down's syndrome, and I judge people by how they treat him. It doesn't matter if you weigh 600 pounds. If you treat him well, you are beautiful."

There is a pause, then a quiet moment of insight offered in a very small voice: "Of course it's a lot easier for me to see beauty in others than in myself." She takes a breath and goes on. "Still, I know more than ever before that there are things about me other than my body. Things that—I can almost say—are beautiful."

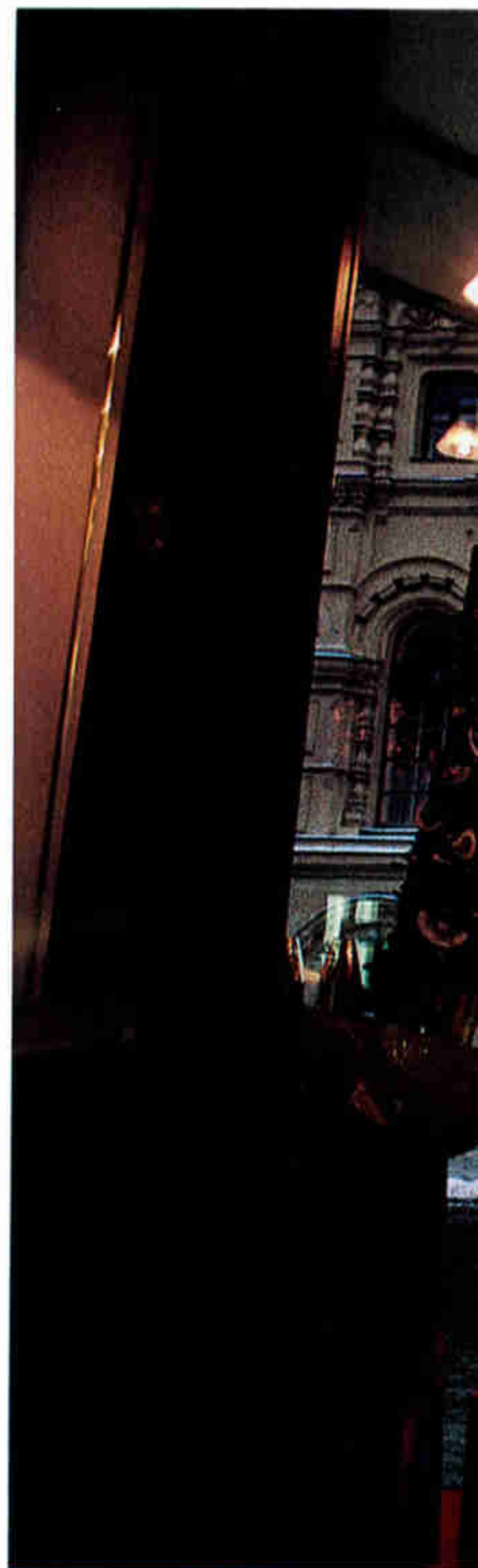
The preoccupation with beauty can be a neurosis, and yet there is something therapeutic about paying attention to how we look and feel.

One day in early spring, I went to Bliss, a spa in New York. It had been a difficult winter, and I needed a bit of buoyancy. At Bliss I could sink back in a sand-colored upholstered chair, gaze at the mural of the seashore on the walls, and laugh as I eased my feet into a basin of warm milk. I could luxuriate in the post-milk rubdown with sea salts and almond oil. Beauty can be sheer self-indulgent pleasure as well as downright fun, and it's best not to forget it.

"People are so quick to say beauty is shallow," says Ann Marie Gardner, beauty director of *W* magazine. "They're fearful. They say: 'It

During the fashion-challenged Soviet era, she might have been derided as decadent. But these days the face of a supermodel reigns triumphant in a cosmetics boutique on Red Square (right)—and in images that glitter around the globe.

What's glorious—and what's grotesque—in our endless quest for beauty is often far more apparent than the motivations behind it. But why we seek beauty is only part of the enigma; how we define it has been, and remains, the most provocative question of all.



doesn't have substance.' What many don't realize is that it's fun to reinvent yourself, as long as you don't take it too seriously. Think of the tribesmen in New Guinea in paint and feathers. It's mystical. It's a transformation. That's what we're doing when we go to a salon. We are transforming ourselves."

UNTIL SHE WAS a hundred years old, my grandmother Mollie Spier lived in a condominium in Hallandale, Florida, and had a "standing," a regular appointment, at the beauty salon down the street. Every Friday she would drive, then later be driven, for a shampoo, set, and manicure.

This past year, too frail to live on her own,



she moved to a nursing home and away from her Friday appointment.

A month before she died, I went to visit her. Before I did, I called to ask if she wanted me to make an appointment for her at the salon.

"I could drive you, Grandma. We could take your nurse and wheelchair. Do you think you could handle it?"

"Of course," she replied, as if I'd asked the silliest question in the world. "What's the big deal? All I have to do is sit there and let them take care of me."

On a Friday afternoon I picked my grandmother up at the nursing home and drove her to the salon she hadn't visited in more than a year. I wheeled her in and watched as she was greeted and fussed over by Luis, who washed

and combed her fine pewter gray hair into swirls, then settled a fog of hair spray over her head.

When he was finished, Yolanda, the manicurist, appeared. "Mollie, what color would you like your nails?"

"What's new this year? I want something no one else has," she shot back, as if in impossibly fast company at the Miami Jewish Home for the Aged.

Afterward I drove my grandmother back to the nursing home. She admired her fire engine red nails every quarter mile. Glancing in the car mirror, she patted her cloud of curls and radiated happiness.

"Mollie," said the nurse behind the desk when I brought her back. "You look absolutely beautiful." □

L I G H T I N



S E L E C T I O N S F R O M T H E W O R K

T H E D E E P

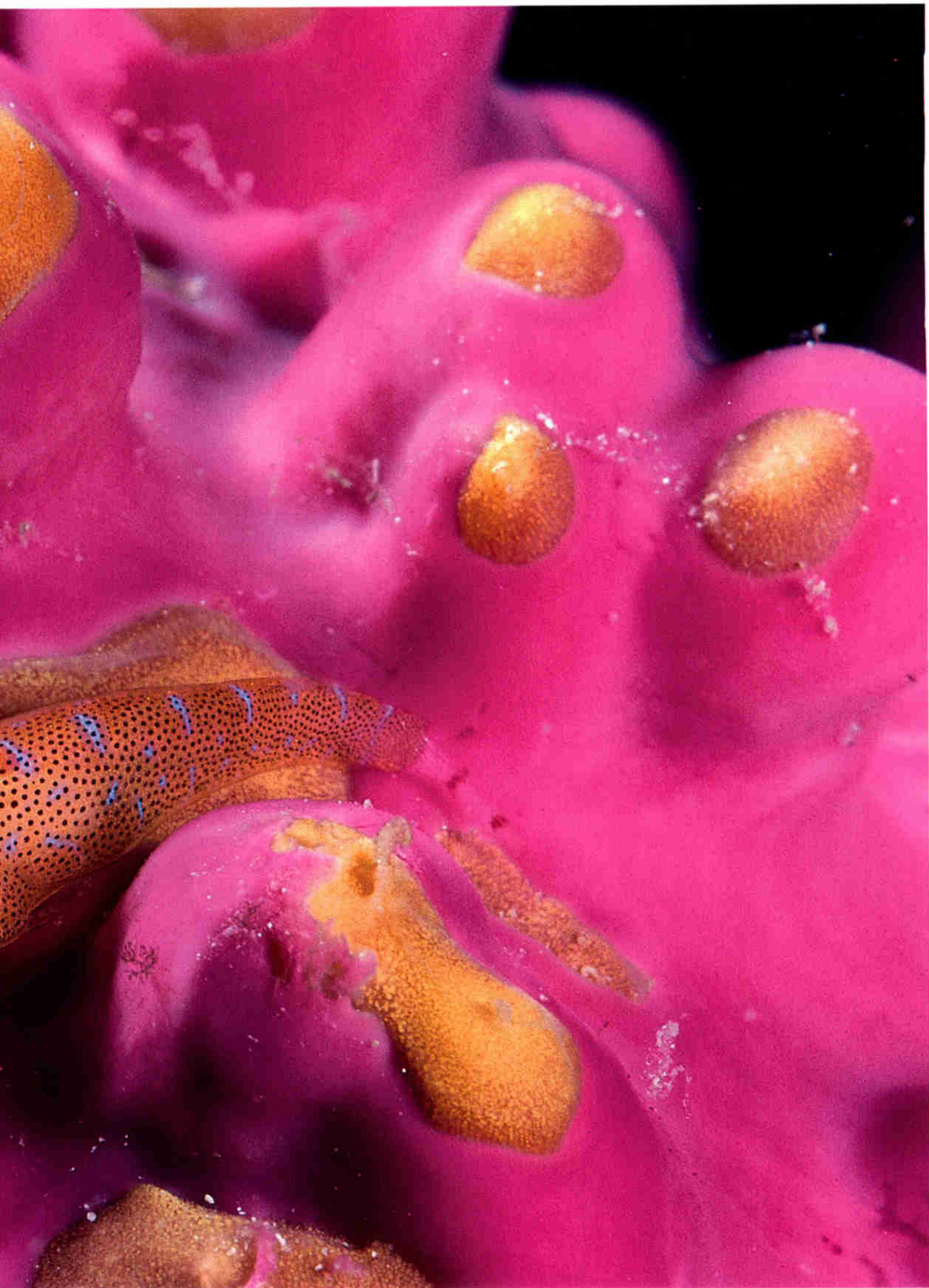


STINGRAY / NORTH SOUND, GRAND CAYMAN

O F D A V I D D O U B I L E T



A PULSE OF MY STROBE LIGHT FLASHES IN A BLUE



CLINGFISH ON ASCIDIAN (SEA TULIP) / JERVIS BAY, NEW SOUTH WALES, AUSTRALIA

COSMOS, AND THE SKIN OF A SEA TULIP BLOOMS PINK FOR AN INSTANT.

A N A P P R E C I A T I O N

B Y P E T E R B E N C H L E Y

“D O YOU REALIZE,” David Doubilet said to me recently, in one of his periodic moments of epiphany, “that it’s only in the last half of the century, here in the last few decades of the millennium, that we—and by ‘we’ I mean mankind—have been able to see, let alone explore, more than two-thirds of our own planet?”

He was right, of course, for though humans have for thousands of years been fascinated, thrilled, and frightened by the water world that covers more than 70 percent of the Earth, not until the 1940s and the invention of the Aqua-Lung were they able to soar beneath the surface of the sea.

“Uh-huh,” I replied, and (loath to be out-epiphanied) added, “do *you* realize that for more than half of *that* time, you’ve been the eyes for millions of people, taking them places they may never go, showing them sights they may never see?”

“Well . . . really . . . I wouldn’t. . . .” Overcome by a flush of modesty, David changed the subject.

I wasn’t just flattering a friend. What I said was more than merely true; it was an



JUVENILE LIONFISH (ACTUAL SIZE) / SURUGA BAY, JAPAN

understatement. Since 1972, when David’s first pictures (of the garden eels in the Red Sea) appeared in the *GEOGRAPHIC*, he has become a master of the intellectually challenging, physically taxing, always changing, and utterly arcane world of underwater photography.

Over the past quarter of a century he has published 50 stories in the *GEOGRAPHIC*, and his images have graced a dozen covers. Though super-

latives are treacherous shoals navigated by the reckless few, I warrant that in his field David has no betters and few, if any, peers. In my judgment he is the finest, most complete underwater still photographer (he doesn’t shoot movies) of our time.

He dives all over the world, from the Sea of Japan to the Sea of the Moon, from the North Sea to the Southern Ocean. On film he has captured all creatures great and small, as well as some creatures never before photographed and (in a few cases) behaviors never before *known*, such as the mating ritual of the gray reef shark.

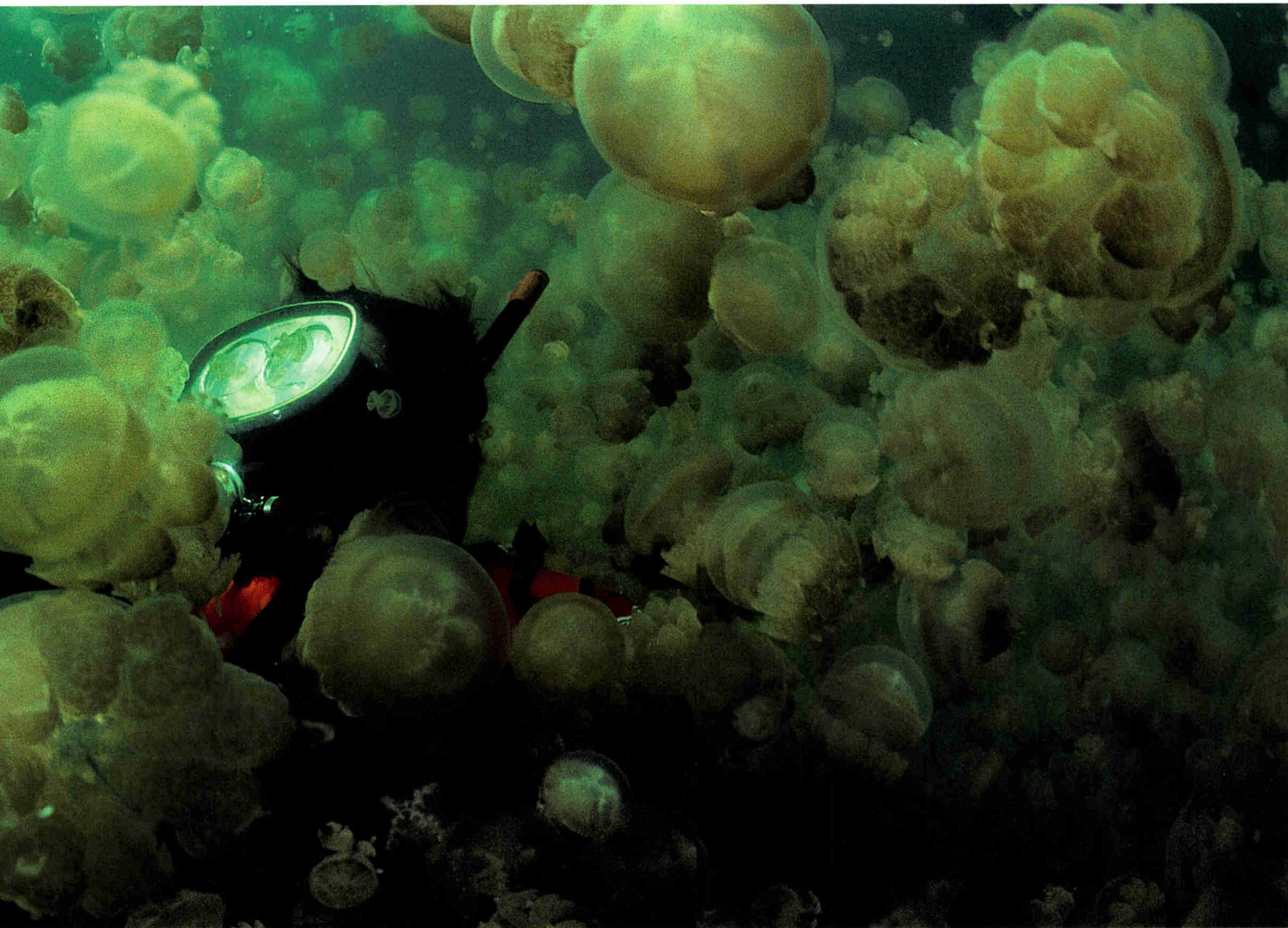
More important, however, than what he has done is how he has done it. These are dicey times for photographers, times of enormous, fundamental change in the way images are made and even in what images *are*. We live in an age when the

PETER BENCHLEY and DAVID DOUBILET first worked together during the filming of *The Deep* in 1976. DAVID DOUBILET’s latest book, *Water Light Time*, by Phaidon Press, illustrates a lifetime under the sea.





BEATING LIKE SOFT HEARTS, CLOUDS OF JELLYFISH



DIVER AMID JELLYFISH / EIL MALK ISLAND, PALAU

FILL THE WARM, SHALLOW WATERS OF A PALAU MARINE LAKE.

technology exists to create—actually fabricate—what once we were able to accept as reliable reflections of reality. Nowadays the cow can be seen to jump over the moon; a snail can be seen to swallow a star. And the temptation can be great to dabble in oxymoronic profundities like “artificial reality” and “subjective truth.”

David will have none of it. He has dedicated—and limited—himself to making images not as he wishes they were, not as he thinks they should be, but as they are.

He seeks not to alter nature but to celebrate it, to wait (and, often, wait and wait) for it to show itself at its most intricate or spectacular or formidable, and then to freeze and illuminate the instant for his, and our, delight. “A strobe light,” he says, “is nothing more than a bottle of sunlight . . . a bloom of light in a dark world.”

Without ever tinkering with reality, David presents a vision as accomplished and personal as that of any painter. Look, for example, at the picture on pages 122-3, the one of the stingray underwater and the sailboat above. Two worlds, each hidden from the other, yet both—astonishingly—available to our eye.

Or check out the swirling barracuda on pages 136-7. I defy you to conclude that that is not an underseascape as breathtaking as any landscape.

WHAT DAVID DOES is a kind of magic, and, like magic, it has secrets that only he knows. I should know them, I suppose, after 20 years of working with him. But just as I don’t want to know how the illusionist on the stage makes the damsel disappear, I don’t *want* to know how David works his magic; I am content to be amazed.

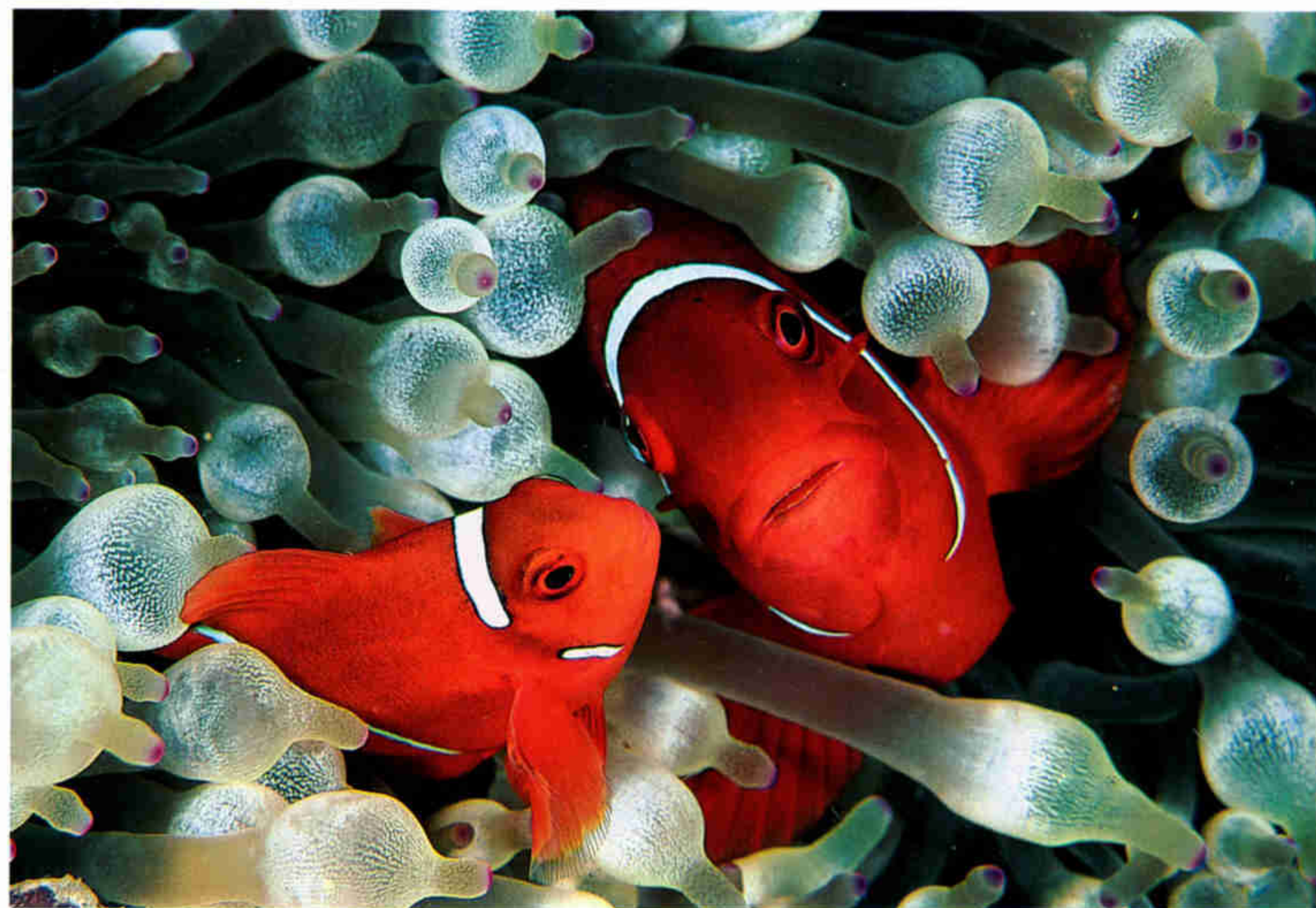
Born in New York, he turned to photography as an escape from sports, at which, he says, he was awkward and clumsy. In the mid-1950s he slipped a primitive mask over his face, put his head in the water off the New Jersey shore . . . and was hooked, immediately and forever. David is the first to admit that he’s lucky (as am I) to be able to make a living doing what he loves. The pictures he takes, however, are born not of luck but of ceaseless, tireless, and carefully planned labor. Like the mason of legend whose fingers had to be pried from his chisel lest he expire in pursuit of perfection, David will hunker down in one spot as long as he has film for his camera and critters in his frame . . . oh yes, and air in his tank, though he breathes with an economy that an otter would envy.

I take peculiar pleasure in sitting on the bottom and watching David descend. Sheathed and hooded in black rubber, armed with two or three or more cameras—some with cyclopean domes, some with articulated appendages adorned with lights—he floats serenely down like a Jedi Knight of the ocean realm.

In his 45 years underwater David has been threatened, frightened, bitten, stung, punctured, and assaulted by everything from moray eels to insidious anemones. And every time he boards a boat, which he does more than a hundred times every year, he knows that he must face one relentless and ubiquitous foe: seasickness.

Now in his 54th year, David is aging as well as one of the single-malt Scotches with which he soothes his bones after a day in the deep. He’s a bottomless well of enthusiasms, for new places to dive, new animals to find, new stories to tell, for vintage cars and exotic aircraft.

Whether he be a hundred feet beneath the sea or 10,000 feet above it, David Doubilet is most at home flying free of the bonds of sullen Earth.



SPINE-CHEEK ANEMONEFISH / PAPUA NEW GUINEA

MOMENTS IN THE SEA ARE GRACED BY WEIGHTLESS, SUBTLE

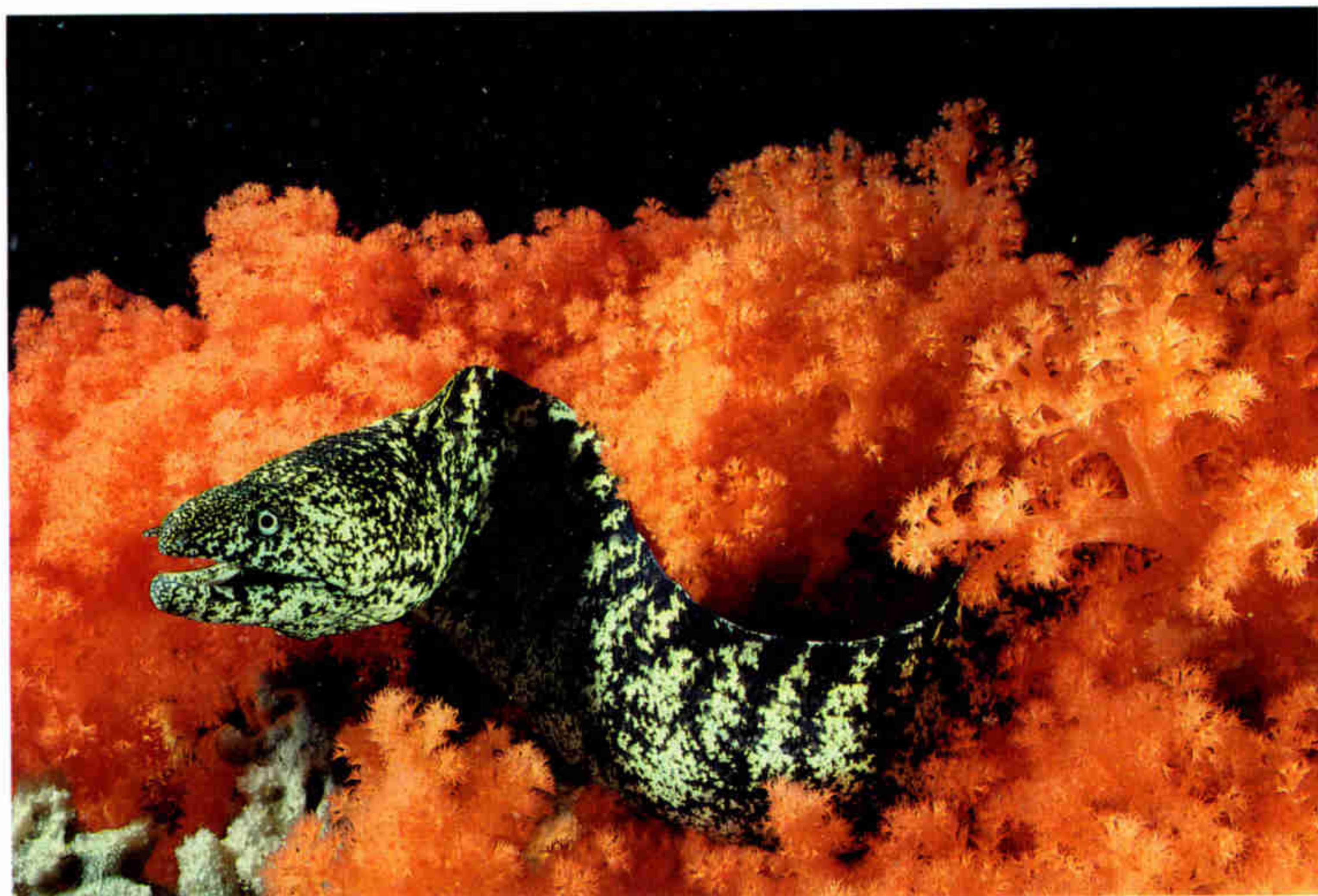


HAWKSBILL TURTLE WITH REMORAS / RED SEA

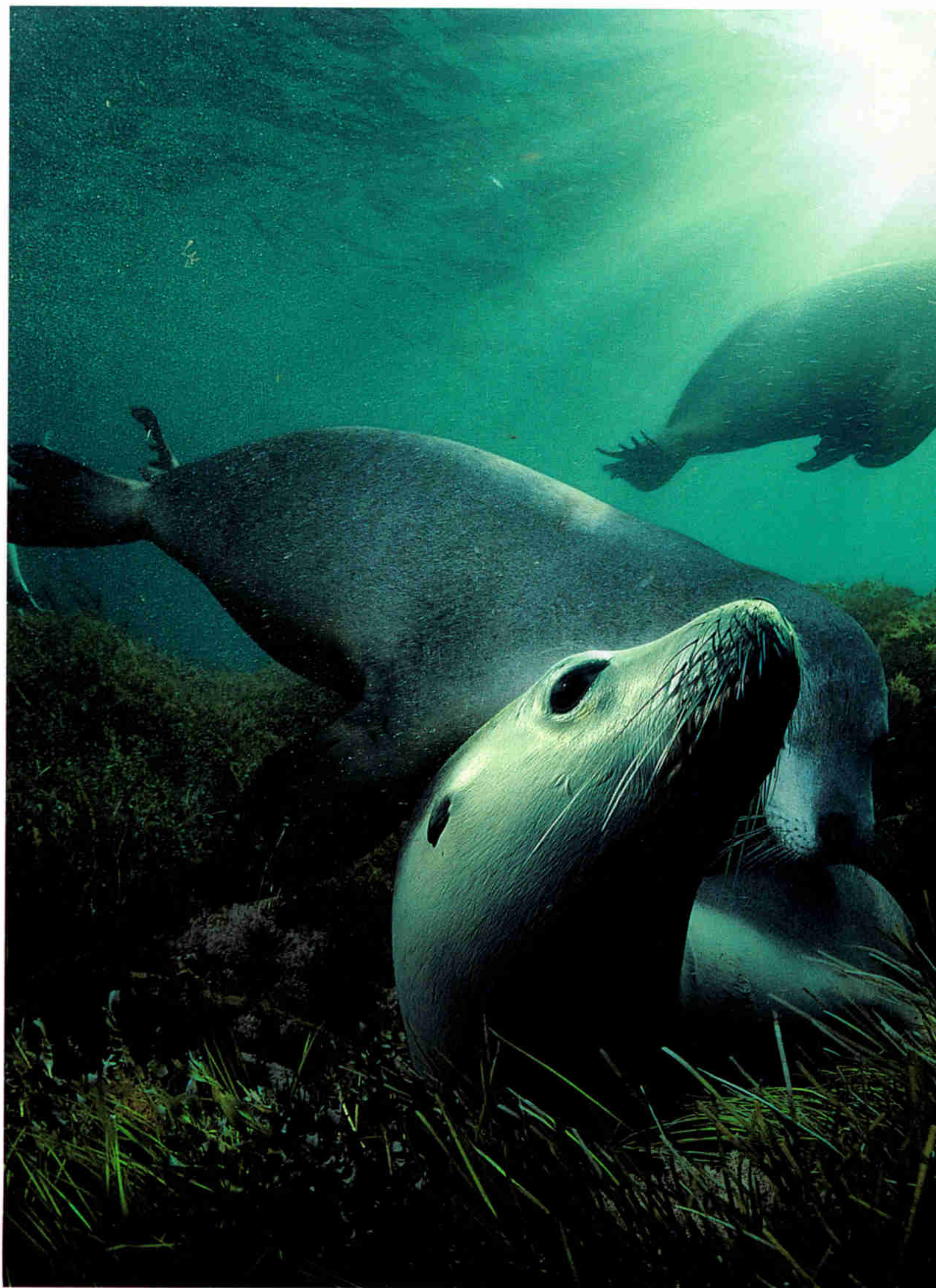


POTBELLIED SEAHORSE / TASMANIA, AUSTRALIA

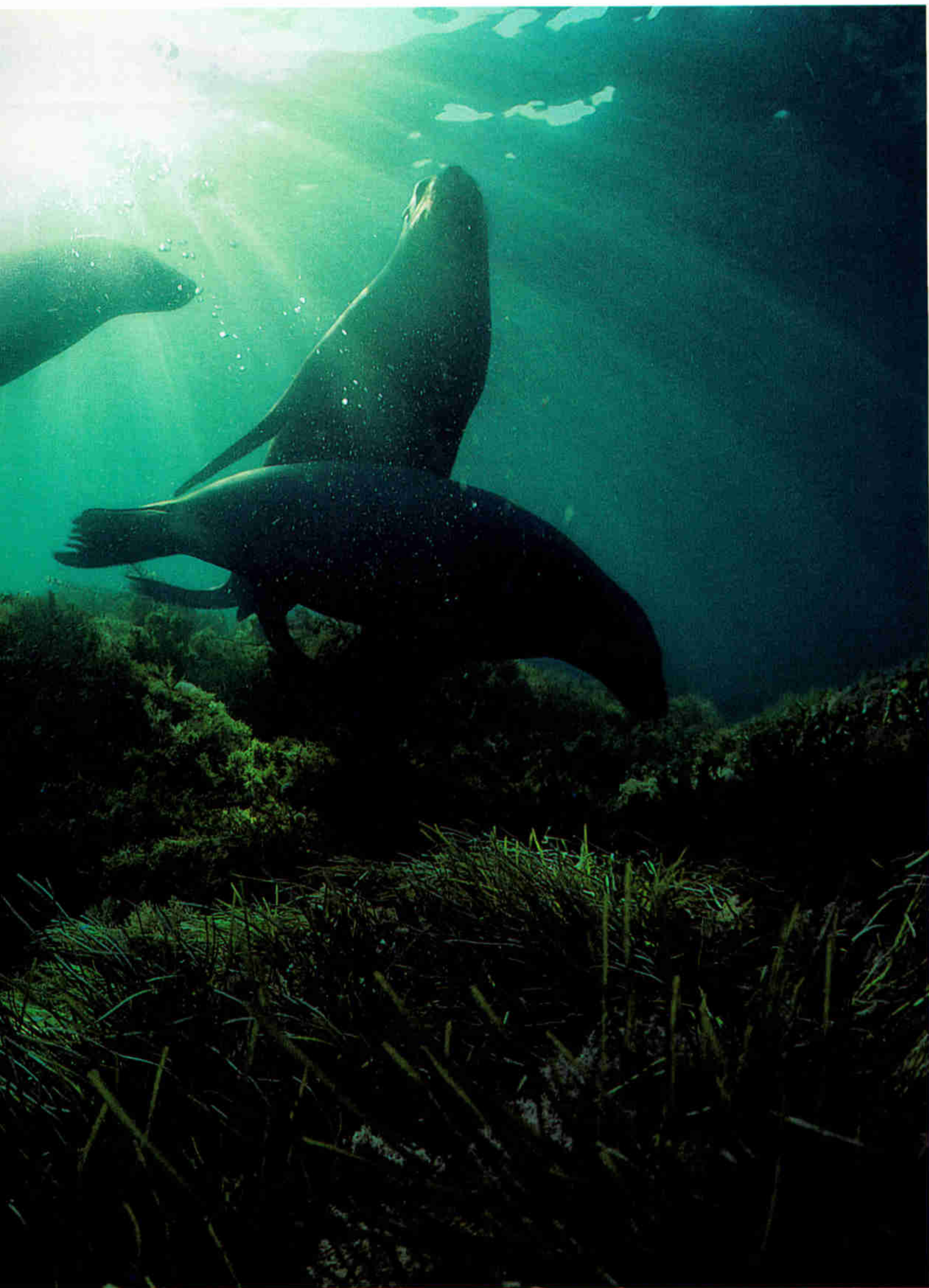
GESTURES: A TURTLE SWIMS AT TWILIGHT; A SEAHORSE HOVERS IN KELP.



MORAY EEL AND SOFT CORALS / IZU PENINSULA, JAPAN



FROM THEIR GRASSY CARPET, SEA LIONS COME TO TICKLE



AUSTRALIAN SEA LIONS / SOUTH AUSTRALIA

MY HANDS WITH THEIR WHISKERS—A WARM MOMENT IN A COLD OCEAN.



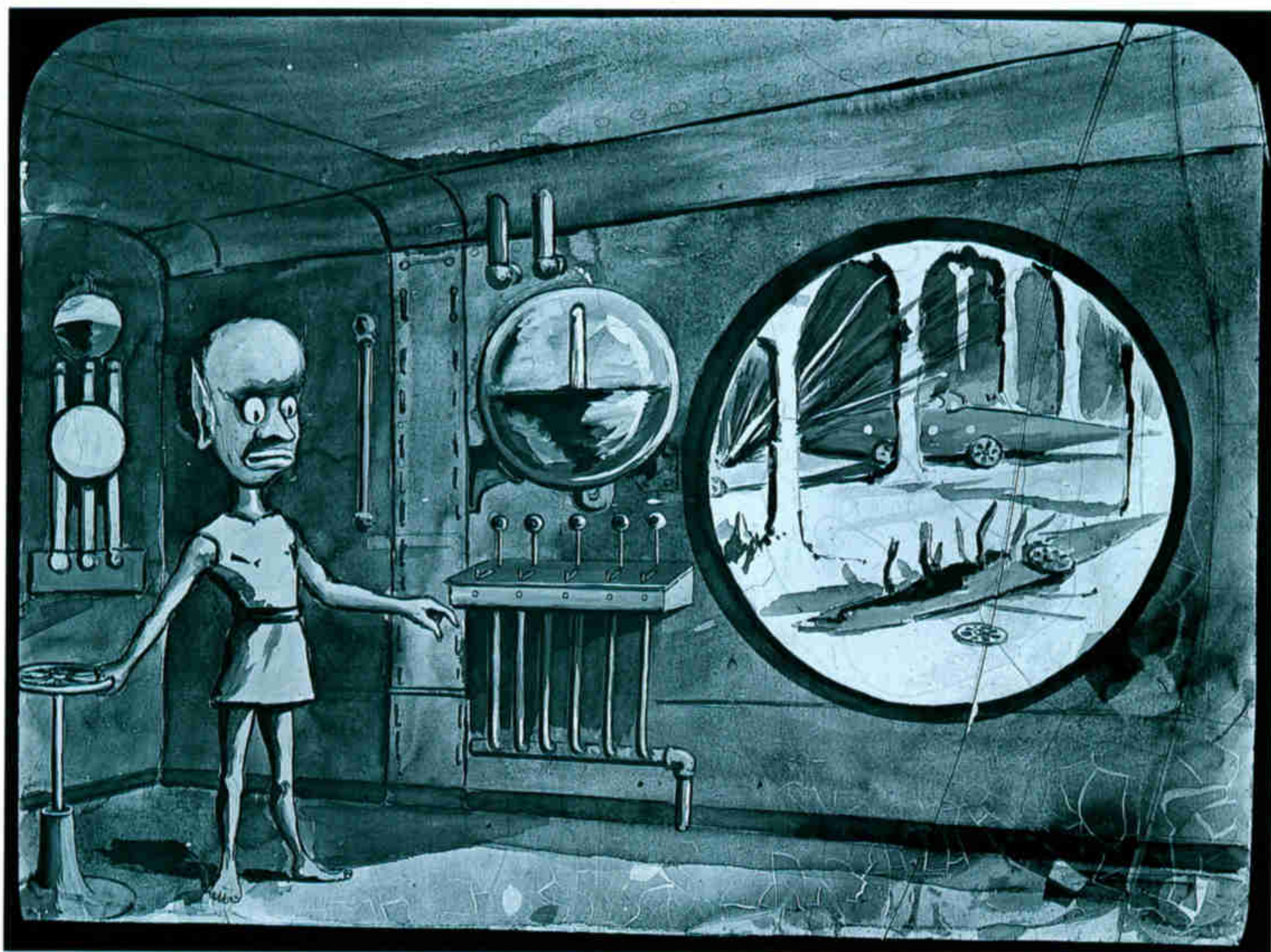
A DEFENSIVE FORMATION SETS BOUNDARIES AROUND A



BARRACUDA CIRCLING / PAPUA NEW GUINEA

DIVER IN A WORLD WITHOUT CORNERS, WITHOUT EDGES, WITHOUT END. □

FLASHBACK



■ FROM THE GEOGRAPHIC ARCHIVES

Out of This World

“Were the Martians you met really as mean looking as you drew them?” an audience member once asked Anthony Fiala, a turn-of-the-century explorer. Fiala had slipped this alien image into his lantern-slide show just for fun, but photos from his actual travels—to the Arctic and the jungles of Brazil—must have seemed nearly as exotic. A former cartoonist, Fiala was just ending a stint as Spanish-American War correspondent for the *Brooklyn Daily Eagle* when he signed on as photographer for an unsuccessful expedition to the North Pole in 1901. He made the first moving pictures ever taken in the Arctic and two years later led his own team to the region, funded in part by the National Geographic Society. Fiala’s group mapped a number of Arctic islands but never quite made it to the Pole.

This Martian has never before been published in the magazine.



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Behind the Scenes

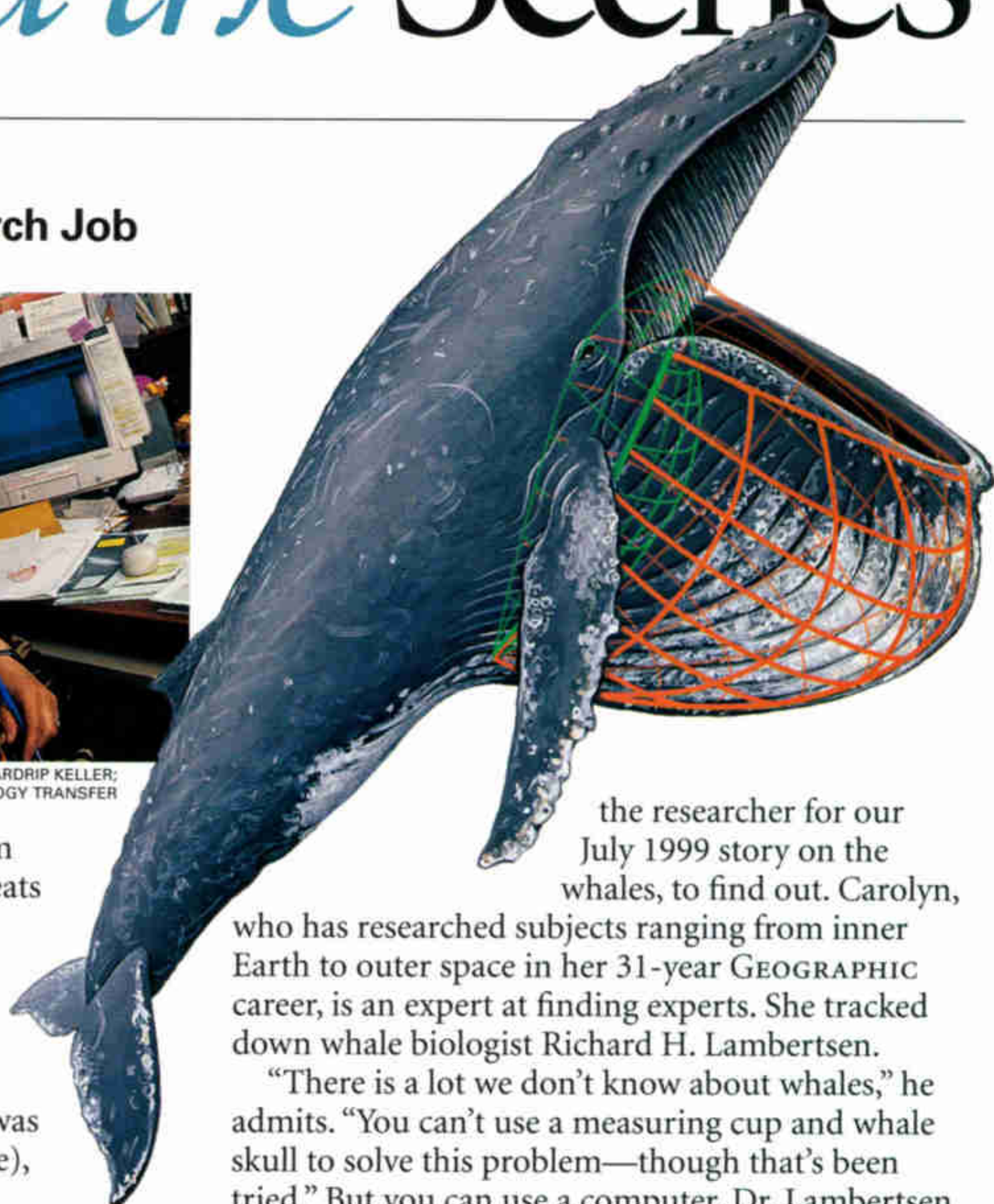
Doing a Whale of a Research Job



MARK THIESSEN, NGS (ABOVE); ART BY JENNY WARDRIP KELLER; MODEL BY R. H. LAMBERTSEN, ECOSYSTEMS TECHNOLOGY TRANSFER

When feeding, humpback whales swim toward drifting clouds of tiny krill. Pleats in the ventral pouch beneath their lower jaw unfold as the whales surge ahead with their mouth wide open. So how much water can a humpback hold?

Until recently nobody knew, but it was the job of Carolyn H. Anderson (above),



the researcher for our July 1999 story on the whales, to find out. Carolyn, who has researched subjects ranging from inner Earth to outer space in her 31-year GEOGRAPHIC career, is an expert at finding experts. She tracked down whale biologist Richard H. Lambertsen.

"There is a lot we don't know about whales," he admits. "You can't use a measuring cup and whale skull to solve this problem—though that's been tried." But you can use a computer. Dr. Lambertsen employed 3-D wire-frame modeling (above) based on skull and body measurements of the animals to figure that a hungry humpback can hold about 15,000 gallons of water at a time.



First Spotted Here

A limited-edition print of this Chris Johns photo from the December 1999 issue is available for \$29.95, plus \$6.50 for postage and handling (\$9.50 for international orders). Please add tax for orders sent to CA, DC, FL, KY, MD, MI, PA, and Canada. We will produce only as many 24-by-36-inch posters as we receive orders for by February 15, 2000. Each hand-numbered print will be embossed with the

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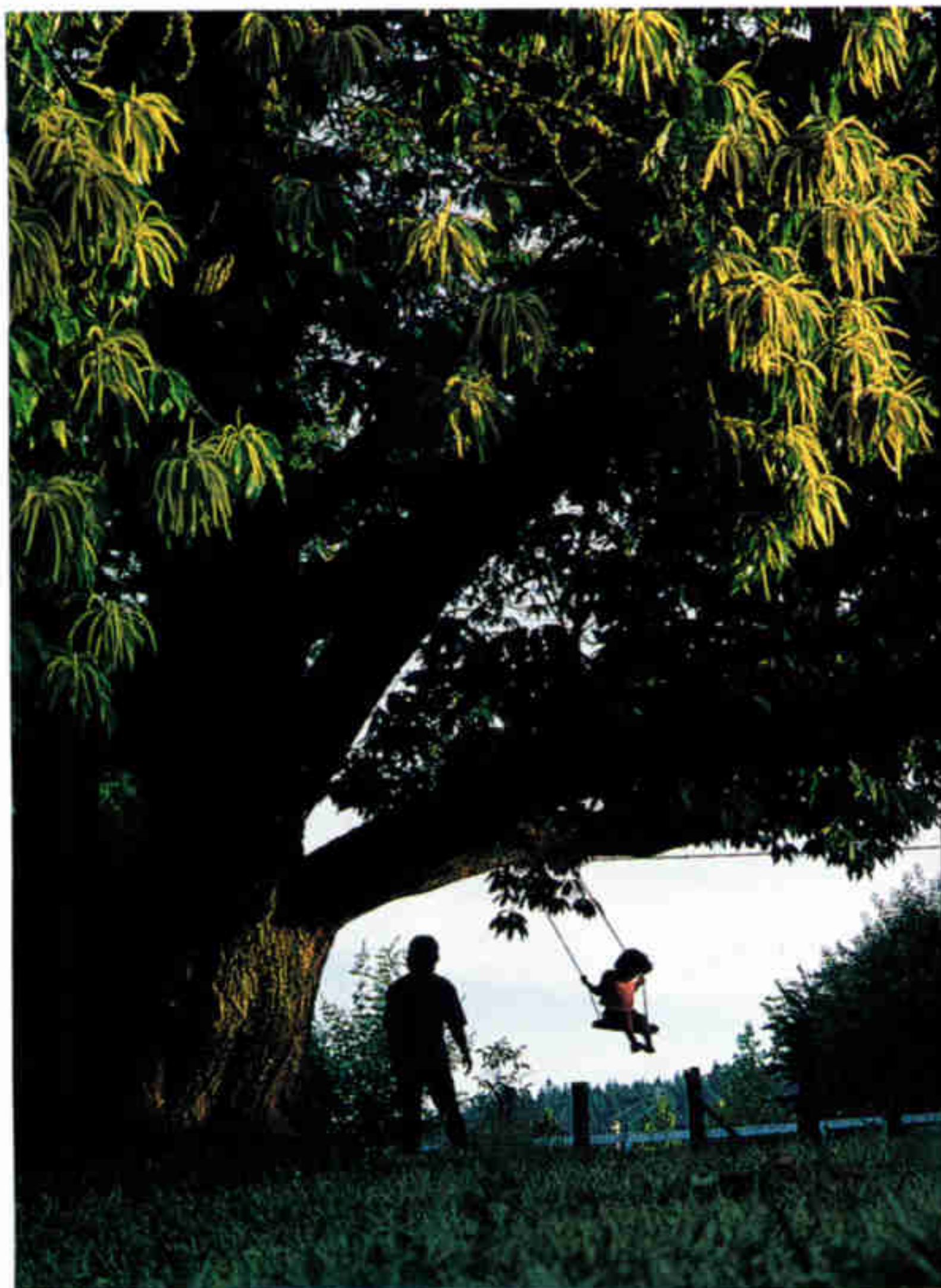
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World Wits



The U.S. team of David Beihl, Jason Borschow, J. B. Kizer, and alternate Evan Sparks bested teams from ten countries to win the International Geography Olympiad in

Toronto last August. Contestants—winners of geography contests in their own countries—vied in written and practical tests.



GARY BRAASCH

That Old Chestnut

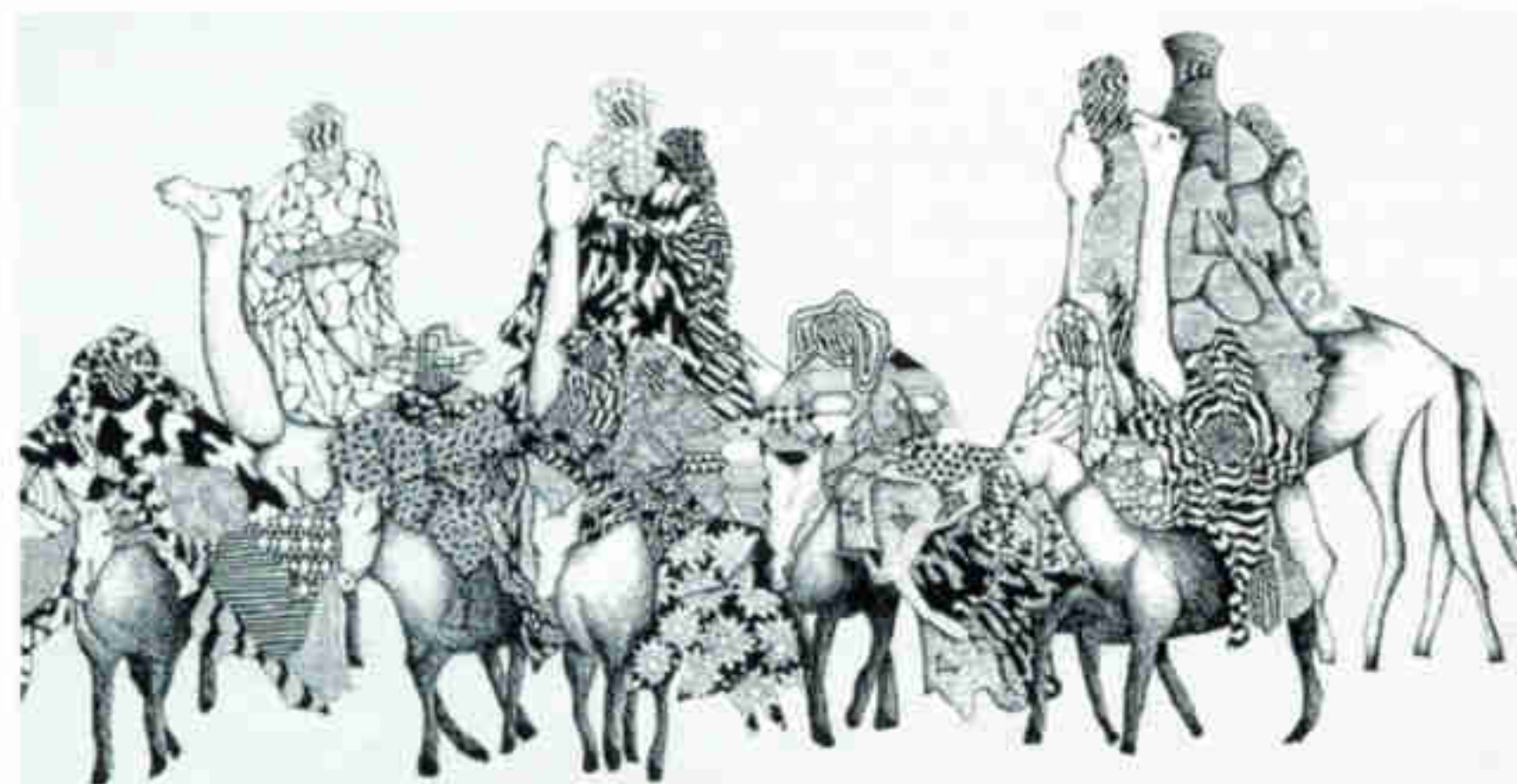
When we published our February 1990 article on efforts to save the American chestnut tree, we had no idea of its far-reaching effects. The American Chestnut Foundation in Vermont, however, felt the results right away. The group's membership immediately increased by one-third, says president Jim Ulring. "We have more than 4,000 members today. And we're still getting people who mention that story when they join."

The growth in membership has meant millions of dollars for study of chestnut blight. The foundation now operates research stations around the country specializing in genetic manipulation and crossbreeding with blight-resistant chestnut varieties. "There's no doubt in my mind," says Ulring, "we'll bring this tree back."

Creative Geography 101

Students from teacher Steve King's art class at Quantico High School in Virginia last year used the *GEOGRAPHIC* to interpret geography through art. Some highlights: Jason Casey's "Croc Croc Croc" (below), Robert Lawless's "Caravan" (bottom), and Laura Holt's untitled collage (right).

TEXT BY MAGGIE ZACKOWITZ



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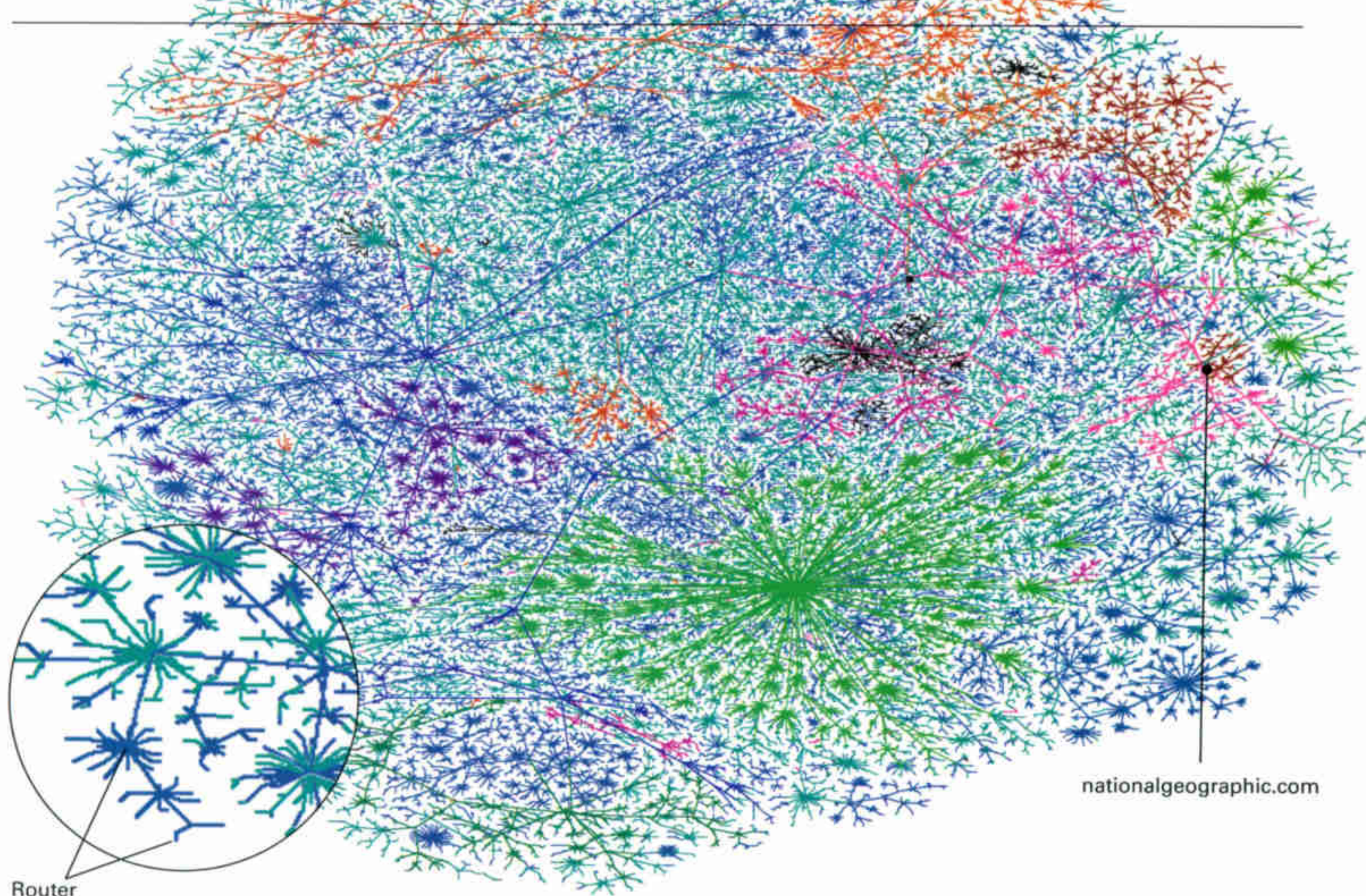
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Router

Colors represent different Internet service providers, organizations that maintain the "tin cans and string" of the Internet. For more maps visit www.nationalgeographic.com.

Mapping Cyberspace

A bug amid a tangled orb, National Geographic's website is one of 88,000 endpoints in this sprawling map of the Internet created by Bill Cheswick and Hal Burch at Bell Laboratories.

Mapping the Internet represents huge challenges. Wires and fiber-optic lines interconnect thousands of "routers," computers that pass on electronic messages from source toward destination. This map shows only the most central routers: An endpoint above might represent a gateway to thousands of other machines.

Most routers don't tout their presence or location. To find them, Cheswick sent out a blizzard of electronic tracers, or packets, from his New

Jersey computer. The messages were designed to "die" as they reached way points or destinations. The machines at which the tracers perished sent back electronic death notices. Burch's program analyzed the notices to build the map, which the team jokingly calls a packet morgue.

Burch and Cheswick's map shows only interconnectivity, but through painstaking detective work Tamara Munzner of Stanford University and her colleagues found the cities in which routers are physically located and created an interactive map that shows connectivity *and* geography (left).

Why make such maps? "Maps help you think about things," says Munzner. Bill Cheswick agrees, adding that maps reveal patterns that generate questions for further research.

TEXT BY ALLEN CARROLL
Chief Cartographer



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■ The advent of the year 2000 offers a chance to reflect on ourselves and our world. Find a multifaceted mirror at [... /2000](http://www.nationalgeographic.com/2000).

■ Why are humans so fascinated with the idea of alien life? Read "Life Beyond Earth" in this issue and comment at [... /ngm/0001](http://www.nationalgeographic.com/ngm/0001).

■ Drop by Info Central for a mini-encyclopedia, website suggestions, and an opportunity to e-mail questions to the Society—all at [... /infocentral](http://www.nationalgeographic.com/infocentral).

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LEFT TO RIGHT: SUN, EUROPEAN SPACE AGENCY/NASA; MERCURY, USGS, FLAGSTAFF, ARIZONA; VENUS, NASA/JET PROPULSION LABORATORY; EARTH, NASA



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